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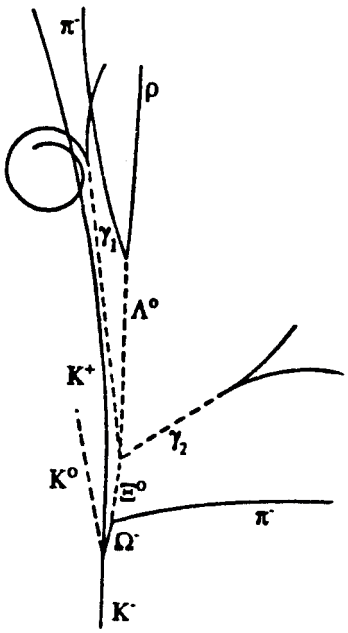

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FRENET VECTORS AND GEODESIC CURVATURES OF SPHERIC INDICATORS OF SALKOWSKI CURVE IN E^3, 485
Sumeyye Gur and **Suleyman Senyurt**
Department of Mathematics
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Ordu University, Ordu, Turkey

ROLE OF AVOGADRO NUMBER IN GRAND UNIFICATION, 513
U. V. S. Seshavatharam
Honorary Faculty, I-SERVE
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INTERACTION OF SLIP AND CHEMICAL REACTION ON PERISTALTIC TRANSPORT OF A NEWTONIAN FLUID WITH VARIABLE VISCOSITY IN AN ASYMMETRIC VERTICAL CHANNEL, 549
A.M. Sobh
Department of Mathematics, Faculty of Applied Science
Al Aqsa University, Gaz, P.O. Box 4051, Palestine
S.S. Al Azab
Head of Mathematatics Department, Faculty of Science
Ain Shams University, Egypt
H.H. Madi
Departmen of Mathematics, College of Science and Technology,
Khan Younis, Palestine

BASES OF CREATIVE PARTICLES OF HIGGS THEORY (CPH THEORY), 509
Hossein Javadi
Invited Professor at Azad Islamic University and Researcher at
Science and Technology Park Tehran University, Iran
Farshid Forouzbakhsh
Academic Researcher, Office of the Vice Chancellor
for Research and Technology, University of Tehran, Tehran, Iran

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FRENET VECTORS AND GEODESIC CURVATURES OF SPHERIC INDICATORS OF SALKOWSKI CURVE IN E^3

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Abstract

In this paper, the spherical indicatrix curves of Salkowski curve the Frenet vectors of this curve and the relations between the derivatives of these vectors are calculated. Also, arc lenght of spherical indicatrix curves and their geodesic curvetures to E^3 and S^2 are found.

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1.Introduction

A slant helix in Euclidean space IR^3 was defined by the property that the principal normal makes a constant angle with a fixed direction, [3]. Morever, Izumiye and Takaeuchi shoewd that γ is a slant helix in IR^3 if and only if the geodesic curvature of principal normal of a space curve γ is a constant function.

Kula and Yayli have studied spherical images of tangent indicatrix and binormal binormal indicatrix of a slant helix and they showed that the spherical images are spherical helix, [4].

In a paper published by E.Salkowski , a curve family, whose curveture is constant ($\kappa = 1$) but torsion is not, ($\tau \neq$constant) has been defined, [7]. In a study done by Monterde, J. , it is found out that base normal vectors of Salkowski curves ($\kappa = 1$, $\tau \neq$constant) make a constant angle with a constant line, [6]. The arc lenghts and geodesic curvatures of spherical indicator of any curve are calculated by Hacisalihoğlu H. , [2]. In a work done by Ekmekci N., Yayli Y. and Ilarslan K. , the relations between Frenet vectors and their derivative vectors of Slant helixes spherical indicators had been given, [5].

In this paper, the spherical indicator curves of Salkowski curve, the Frenet vectors of these curves and the relations between the derivatives of these vectors are calculated. In addition, arc lenght of spherical indicator curves and their geodesic curvetures to E^3 and S^2 are found.

2.Basic Concepts

Let $\alpha : I \to IR^3$ be a diferentiable curve, the Frenet frame of α at the point $\alpha(t)$ is $\{T(t), N(t), B(t)\}$, where

$$\begin{aligned} T(t) &= \frac{\alpha'(t)}{\|\alpha'(t)\|} \\ N(t) &= B(t) \wedge T(t) \\ B(t) &= \frac{\alpha'(t) \wedge \alpha''(t)}{\|\alpha'(t) \wedge \alpha''(t)\|} \end{aligned}$$

$\alpha : I \to IR^3$ curve is given. Supposing $a \leq t \leq b$ the real number $\int_a^b \| \frac{d\alpha}{dt} \| \, dt$ between the $\alpha(a)$ and $\alpha(b)$ points is called arc lenght of the curve α. Let $T(t)$ be the tangent vector of curve α at the point of $\alpha(t)$, $k_g = \|D_T T\| = \left\| \frac{d^2\alpha}{dt^2} \right\|$ is the geodesic curveture to E^3 and $\gamma_g = \left\| \overline{D}_T T \right\|$ is the geodesic curveture to S^2 . Here, D and $\overline{D}$ are the connections of E^3 and S^2, respectively.

Let α be a regular curve in Euclidean 3-space with Frenet vectors T, N and B.The unit tangent vectors along the curve α generate a curve (T) on the sphere of radius 1 about the origin. The curve (T) is called the spherical indicatrix of t or more commonly, (T) is called tangent indicatrix of the curve α. If $\alpha = \alpha(t)$ is a natural representation of α, then $(T) = T(t)$ will be a representation of (T). Similarly one considers the principal normal indicatrix $(N) = N(t)$ and binormal indicatrix $(B) = B(t)$ [8]. The parameters for (T), $(N), (B)$ are t_T , t_N, t_B , respectively, and equations for these curves are ;

$$\begin{array}{l} (T) = \alpha(t_T) = T(t) \\ (N) = \alpha(t_N) = N(t) \\ (B) = \alpha(t_B) = B(t) \end{array} \tag{1}$$

If the Frenet frame of tangent indicatrix (T) curve α is $\{T_T(t), N_T(t), B_T(t)\}$, curvature is κ_T and torsion is τ_T, then we have Frenet-Serret formulas:

$$\begin{aligned} D_{T_T} T_T &= \kappa_T N_T \\ D_{T_T} N_T &= -\kappa_T T_T + \tau_T B_T \\ D_{T_T} B_T &= -\tau_T N_T \; N_T \end{aligned} \tag{2}$$

where

$$\begin{aligned} T_T &= N \\ N_T &= \frac{1}{\sqrt{\kappa^2+\tau^2}}\left(-\kappa T+\tau B\right) \\ B_T &= \frac{1}{\sqrt{\kappa^2+\tau^2}}\left(\tau T+\kappa B\right) \end{aligned} \tag{3}$$

and

$$\begin{aligned} \kappa_T &= \frac{\sqrt{\kappa^2+\tau^2}}{\kappa} \\ \tau_T &= \frac{\kappa\tau^{'}-\kappa^{'}\tau}{\kappa\left(\kappa^2+\tau^2\right)} \end{aligned} . \tag{4}$$

If the Frenet frame of principal normal indicatrix (N) curve α is $\{T_N(t), N_N(t), B_N(t)\}$, curvature is κ_N and torsion is τ_N, then we have Frenet-Serret formulas:

$$\begin{aligned} D_{T_N}T_N &= \kappa_N N_N \\ D_{T_N}N_N &= -\kappa_N T_N+\tau_N B_N \\ D_{T_N}B_N &= -\tau_N N_N \end{aligned} \tag{5}$$

where

$$\begin{aligned} T_N &= \frac{1}{\sqrt{\kappa^2+\tau^2}}\left(-\kappa T+\tau B\right) \\ N_N &= \frac{1}{\sqrt{\left(\kappa^2+\tau^2\right)\left(\kappa\tau'-\kappa'\tau\right)^2+\left(\kappa^2+\tau^2\right)^4}}\cdot \\ &\quad \left[\left(\kappa\tau^{'}-\kappa^{'}\tau\right)\left(\tau T+\kappa B\right)-\left(\kappa^2+\tau^2\right)^2 N\right] \\ B_N &= \frac{1}{\sqrt{\left(\kappa\tau'-\kappa'\tau\right)^2+\left(\kappa^2+\tau^2\right)^3}}\cdot \\ &\quad \left[\left(\kappa^2+\tau^2\right)\left(\tau T+\kappa B\right)-\left(\kappa\tau^{'}-\kappa^{'}\tau\right) N\right] \end{aligned} \tag{6}$$

and

$$\begin{aligned} \kappa_N &= \frac{\left(\kappa\tau^{'}-\kappa^{'}\tau\right)^2+\left(\kappa^2+\tau^2\right)^3}{\left(\kappa^2+\tau^2\right)^{3/2}} \\ \tau_N &= \frac{\left[\left(\kappa\tau^{''}-\kappa^{''}\tau\right)\left(\kappa^2+\tau^2\right)-3\left(\kappa\tau^{'}-\kappa^{'}\tau\right)\left(\kappa\kappa^{'}-\tau^{'}\tau\right)\right]}{\left(\kappa\tau^{'}-\kappa^{'}\tau\right)^2+\left(\kappa^2+\tau^2\right)^3} \end{aligned} \tag{7}$$

If the Frenet frame of binormal indicatrix (B) curve α is $\{T_B(t), N_B(t), B_B(t)\}$, curvature is κ_B and torsion is τ_B, then we have Frenet-Serret formulas:

$$\begin{aligned} D_{T_B}T_B &= \kappa_B N_B, \\ D_{T_B}N_B &= -\kappa_B T_B+\tau_B B_B, \\ D_{T_B}B_B &= -\tau_B N_B \end{aligned} \tag{8}$$

where

$$\begin{aligned} T_B &= -N, \\ N_B &= \frac{1}{\sqrt{\kappa^2+\tau^2}}\left(\kappa T-\tau B\right), \\ B_B &= \frac{1}{\sqrt{\kappa^2+\tau^2}}\left(\tau T+\kappa B\right) \end{aligned} \tag{9}$$

and

$$\begin{aligned} \kappa_B &= \frac{\sqrt{\kappa^2+\tau^2}}{\kappa}, \\ \tau_B &= -\frac{\kappa\tau^{'}-\kappa^{'}\tau}{\tau\left(\kappa^2+\tau^2\right)} \end{aligned} \tag{10}$$

[5].

Let $\alpha: I \to IR^3$ be a curve at the point $\alpha(t)$, $\{T(t), N(t), B(t)\}$ makes an immadiate helix around the axis movement while moving along the curve. This vector in the direction of axis is called Darboux Vector and given as

$$W = \tau T + \kappa B \tag{11}$$

Let φ be the angel between the W and B, and let C be the unit vector in the direction of Darboux, then we have

$$C = \sin\varphi T + \cos\varphi B,$$

where

$$\begin{array}{l} \cos\varphi = \frac{\kappa}{\|W\|} \\ \sin\varphi = \frac{\tau}{\|W\|} \end{array} . \tag{12}$$

Definition 1 *For any $m \in IR$ with $m \neq \pm\frac{1}{\sqrt{3}}, 0$ let us define the space curve*

$$\begin{aligned} \alpha_m(t) &= \frac{1}{\sqrt{1+m^2}}[-\frac{1-n}{4(1+2n)}\sin((1+2n)t) \\ &\quad -\frac{1+n}{4(1-2n)}\sin((1-2n)t) \\ &\quad -\frac{1}{2}\sin t - \frac{1}{2}\sin t, \frac{1-n}{4(1+2n)}\cos((1+2n)t) \\ &\quad +\frac{1+n}{4(1-2n)}\cos((1-2n)t) + \frac{1}{2}\cos t, \frac{1}{4m}\cos(2nt)] \end{aligned} \tag{13}$$

is called **Salkowski Curve**. Here $n = \frac{m}{\sqrt{m^2+1}}$
Geometric elements of this curve are ;
$1)\left\|\alpha_m'(t)\right\| = \frac{\cos(nt)}{\sqrt{m^2+1}}$, so the curve is regular on the interval $]-\frac{\pi}{2n}, \frac{\pi}{2n}[$
$2)\kappa(t) = 1$ and $\tau(t) = \tan(nt)$
and the Frenet frame is

$$\begin{aligned} T(t) &= (-\cos(t)\cos(nt) + n\sin(t)\sin(nt), \\ &\quad \cos(nt)\sin(t) - n\cos(t)\sin(nt), \frac{n}{m}\sin(nt)) \\ N(t) &= (\frac{n\sin(t)}{m}, -\frac{n\cos(t)}{m}, -n) \\ B(t) &= (n\cos(nt)\sin(t) - n\cos(t)\sin(nt), \\ &\quad -\cos(t)\cos(nt) - \sin(t)\sin(nt), \frac{n}{m}\cos(nt)) \end{aligned} \tag{14}$$

[6].

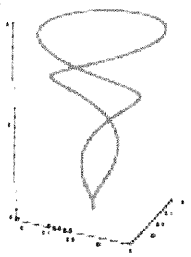


Figure 1.*Salkowski curve with* $\kappa = 1$ *for* $m = 1/8$, *plotted for* $t\epsilon\left[-\frac{\pi}{2n}, \frac{\pi}{2n}\right]$.

3.Spherical Indicatrix Curves of Frenet Vectors of Salkowski Curve

We are going to calculate the Darboux vector and the unit vector in the direction of this vector before we start with the spherical indicatrix curves of Frenet vectors of Salkowski curve. Let W be Darboux vector of Salkowski curve;

$$W(t) = \left(\frac{n^2}{m}\sin(t), -\frac{n^2}{m}\cos t, \frac{n^2}{m^2}\right) \tag{15}$$

will be found out.

Let $\{T_T(t), N_T(t), B_T(t)\}$ be the Frenet frame of spherical indicatrix $T(t)$ of Salkowski curve

$$\begin{aligned} T_T &= \left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right), \\ N_T &= (\cos(t), \sin(t), 0) \\ B_T &= \left(n\sin(t), -n\cos(t), \frac{n}{m}\right) \end{aligned} \tag{16}$$

Graphs of the curves are like to be in figure 2.a). Actually, if the derivative of the vector

$$\begin{aligned} T(t) &= (\cos(t)\cos(nt) + n\sin(t)\sin(nt), \cos(nt)\sin(t) - n\cos(t)\sin(nt), \\ &\quad \frac{n}{m}\sin(nt)) \end{aligned}$$

is calculated

$$T_T = \frac{T'(t)}{\|T'(t)\|} = \left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right).$$

we have. Since

$$B_T = \frac{T'(t) \wedge T''(t)}{\|T'(t) \wedge T''(t)\|},$$

we have

$$B_T = \left(n\sin(t), -n\cos(t), \frac{n}{m}\right)$$

and

$$N_T = B_T \wedge T_T$$

we get

$$N_T = (\cos(t), \sin(t), 0).$$

Theorem 2 *If curveture is κ_T and torsion is τ_T of the spherical indicatrix curve (T),*

$$\kappa_T = \frac{1}{\cos(nt)} \quad \text{and} \quad \tau_T = -\frac{m}{\cos(nt)}. \tag{17}$$

Proof. If the derivative of the curve (T) we get

$$T_T = \frac{dT}{dt}\frac{dt}{dt_T}.$$

Then we calculate the norms and have the equation

$$\frac{dt}{dt_T} = \frac{m}{n\cos(nt)}$$

If we calculate the derivate of T_T in (16) to t_T, we find

$$D_{T_T}T_T = \left(\frac{\cos(t)}{\cos(nt)}, \frac{\sin(t)}{\cos(nt)}, 0\right). \tag{18}$$

Graph of the curve is like to be in figure 2.c). Since

$$\kappa_T = \langle D_{T_T}T_T, N_T\rangle$$

we have

$$\kappa_T = \frac{1}{\cos(nt)}.$$

If we calculate the derivate of N_T in (16) to t_N, we find

$$D_{T_T}N_T = \left(-\frac{m\sin(t)}{n\cos(nt)}, \frac{m\cos(t)}{n\cos(nt)}, 0\right) \tag{19}$$

Graph of the curve is like to be in figure 2.d). Since

$$\tau_T = \langle D_{T_T}N_T, B_T\rangle$$

we have

$$\tau_T = -\frac{m}{\cos(nt)}.$$

■

Theorem 3 *Frenet-Serret formulas of the spherical indicatrix curve* (T)

$$\begin{aligned} D_{T_T}T_T &= \left(\frac{\cos(t)}{\cos(nt)}, \frac{\sin(t)}{\cos(nt)}, 0\right) \\ D_{T_T}N_T &= \left(-\frac{m\sin(t)}{n\cos(nt)}, \frac{m\cos(t)}{n\cos(nt)}, 0\right) \\ D_{T_T}B_T &= \left(\frac{m\cos(t)}{\cos(nt)}, \frac{m\sin(t)}{\cos(nt)}, 0\right) \end{aligned}$$

Proof. $D_{T_T}T_T$ and $D_{T_T}N_T$ statements were found (3.4) and (3.5). If we find derivative of B_T to t_T , we will get

$$D_{T_T}B_T = \left(\frac{m\cos(t)}{\cos(nt)}, \frac{m\sin(t)}{\cos(nt)}, 0\right). \tag{20}$$

Graph of the curve is like to be in figure 1.c). ■

Besides, we can write

$$D_{T_T}T_T = \frac{1}{\cos(nt)}(\cos(t), \sin(t), 0)$$

from (3.4). If we put value κ_T in (3.3) and value N_T in (16) to their places we will get

$$D_{T_T}T_T = \kappa_T N_T.$$

We can write

$$\begin{aligned} D_{T_T}N_T &= -\frac{1}{\cos(nt)}\left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right) \\ &\quad -\frac{m}{\cos(nt)}\left(n\sin(t), -n\cos(t), \frac{n}{m}\right) \end{aligned}$$

from (3.5). Here when we pay attention (16) and (3.3) we can see

$$D_{T_T}N_T = -\kappa_T T_T + \tau_T B_T.$$

Likewise, we write

$$D_{T_T}B_T = -\left(-\frac{m}{\cos(nt)}\right)(\cos(t), \sin(t), 0)$$

from (3.6). Here, if we put value τ_T in (3.3) and value N_T in (16) to their places we will get

$$D_{T_T}B_T = -\tau_T N_T.$$

So correlations at (2) will be satisfied as a conculussion from Theorem 2.
If Darboux vector the spherical indicatrix curve (T) is W_T, since

$$W_T = N_T \wedge D_{T_T}N_T$$

we get

$$W_T = \left(0, 0, \frac{m}{n\cos(nt)}\right). \tag{21}$$

Theorem 4 *For spherical indicatrix curve (T) there are such λ and μ values which satisfiy $T' + \lambda T'' + \mu T''' = 0$:*

$$\lambda = \sin(t)\cos(nt)\left(\frac{\left(-\frac{\cos(t)}{\cos(nt)}-\frac{2\sin(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\cos(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\cos(t)n^2}{\cos(nt)}\right)m}{n\cos(nt)+\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{\cos(t)\cos(nt)n}{\cos^2(nt)}\right)m\sin(nt)}{\cos^2(nt)}}\right)$$

$$+\cos(t)\cos(nt)\left(\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{2\cos(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\sin(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\sin(t)n^2}{\cos(nt)}\right)m}{n\cos(nt)+\frac{\left(\frac{\cos(t)}{\cos(nt)}+\frac{\sin(t)\sin(nt)n}{\cos^2(nt)}\right)m\sin(nt)}{\cos^2(nt)}}\right)$$

and

$$\mu = \left(\frac{\cos(t)\cos(nt)+\sin(t)\sin(nt)n}{n\cos(nt)}\right)\cdot\left(\frac{\left(-\frac{\cos(t)}{\cos(nt)}-\frac{2\sin(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\cos(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\cos(t)n^2}{\cos(nt)}\right)m^2}{n\sin(nt)+\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{\cos(t)\sin(nt)n}{\cos^2(nt)}\right)m^2\sin(nt)}{\sin^2(nt)}}\right)$$

$$\left(\frac{\sin(t)\cos(nt)-\cos(t)\sin(nt)n}{n\cos(nt)}\right)\cdot\left(\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{2\cos(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\sin(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\sin(t)n^2}{\cos(nt)}\right)m^2}{n\sin(nt)-\frac{\left(\frac{\cos(t)}{\cos(nt)}-\frac{\sin(t)\sin(nt)n}{\cos^2(nt)}\right)m^2\sin(nt)}{\cos^2(nt)}}\right).$$

Proof. If we calculate the derivative of (19) to t_T

$$T'' = \frac{m}{n\cos(nt)}\left(-\frac{\sin(t)}{\cos(nt)}+\frac{\cos(t)\sin(nt)n}{\cos^2(nt)},\frac{\cos(t)}{\cos(nt)}-\frac{\sin(t)\sin(nt)n}{\cos^2(nt)},0\right)$$

$$T''' = \frac{m}{n\cos(nt)}\left(\frac{\left(-\frac{\cos(t)}{\cos(nt)}-\frac{2\sin(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\cos(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\cos(t)n^2}{\cos(nt)}\right)m}{n\cos(nt)}+\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{\cos(t)\sin(nt)n}{\cos^2(nt)}\right)m\sin(nt)}{\cos^2(nt)},\right.$$

$$\left.\frac{\left(-\frac{\sin(t)}{\cos(nt)}+\frac{2\cos(t)\sin(nt)n}{\cos^2(nt)}+\frac{2\sin(t)\sin^2(nt)n^2}{\cos^3(nt)}+\frac{\sin(t)n^2}{\cos(nt)}\right)m}{n\cos(nt)}+\frac{\left(\frac{\cos(t)}{\cos(nt)}+\frac{\sin(t)\sin(nt)n}{\cos^2(nt)}\right)m\sin(nt)}{\cos^2(nt)},0\right)$$

are found. If we replace these in the equation $T' + \lambda T'' + \mu T''' = 0$ we find.

■

Let $\{T_N(t), N_N(t), B_N(t)\}$ be the Frenet frame of spherical indicatrix $N(t)$ of Salkowski curve

$$\begin{aligned} T_N &= (\cos(t), \sin(t), 0) \\ N_N &= (-\sin(t), \cos(t), 0) \\ B_N &= (0, 0, 1) \end{aligned} \tag{22}$$

Actually, if we derivative of the vector

$$N(t) = \left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right)$$

we have

$$T_N = \frac{N'(t)}{\|N'(t)\|} = (\cos(t), \sin(t), 0).$$

Graph of the curve is like to be in figure 2.a). Since

$$B_N = \frac{N'(t) \wedge N''(t)}{\|N'(t) \wedge N''(t)\|},$$

we have

$$B_N = (0, 0, 1)$$

and since

$$N_N = B_N \wedge T_N,$$

we get

$$N_N = (-\sin(t), \cos(t), 0).$$

Graph of the curve is like to be in figure 2.a).

Theorem 5 *If curvature is κ_N and torsion is τ_N of the speherical indicatrix curve (N),*

$$\kappa_N = \frac{n}{m} \quad \text{and} \quad \tau_N = 0. \tag{23}$$

Proof. If the derivative of the curve (N) we get

$$T_N = \frac{dN}{dt}\frac{dt}{dt_N}.$$

Then we calculate the norms and have the equation and put the values $\kappa = 1$ and $\tau = \tan(nt)$ to their places

$$\frac{dt}{dt_N} = \frac{m}{n}$$

will be found. If we find derivative of T_N in (3.8) to t_N , we will get

$$D_{T_N} T_N = \left(-\frac{m}{n} \sin(t), \frac{m}{n} \cos(t), 0 \right). \tag{24}$$

Graph of the curve is like to be in figure 2.a). Since

$$\kappa_N = \langle D_{T_N} T_N, N_N \rangle$$

we have

$$\kappa_N = \frac{m}{n}.$$

Likewise, if we calculate derivative of N_N in (3.8) to t_N we will get

$$D_{T_N} N_N = \left(-\frac{m}{n} \cos(t), -\frac{m}{n} \sin(t), 0 \right). \tag{25}$$

Graph of the curve is like to be in figure 2.a). Since

$$\tau_N = \langle D_{T_N} N_N, B_N \rangle$$

we get

$$\tau_N = 0.$$

■

Theorem 6 *Frenet-Serret formulas of the spherical indicatrix curve* (N)

$$\begin{aligned} D_{T_N} T_N &= \left(-\frac{m}{n} \sin(t), \frac{m}{n} \cos(t), 0 \right) \\ D_{T_N} N_N &= \left(-\frac{m}{n} \cos(t), -\frac{m}{n} \sin(t), 0 \right) \\ D_{T_N} B_N &= (0, 0, 0) \end{aligned}$$

Proof. The statements $D_{T_N}T_N$ and $D_{T_N}N_N$ have been found out at (3.10) and (3.11). If we find derivative of B_N in (3.8) to t_N we will get,

$$D_{T_N}B_N = (0,0,0)\,. \tag{26}$$

Besides, from the equation (3.10) we can write

$$D_{T_N}T_N = (-\sin(t)\,,\cos(t)\,,0)\,\frac{m}{n}.$$

Here, if we pay attention to the values κ_N and N_N ,

$$D_{T_N}T_N = \kappa_N N_N$$

will be found out. From the equation (3.11) we can write

$$D_{T_N}N_N = -\frac{m}{n}\,(\cos(t)\,,\sin(t)\,,0) + 0\,(0,0,1)\,.$$

Here, if we pay attention to the statements (3.8) and (3.9), it will be

$$D_{T_N}N_N = -\kappa_N T_N + \tau_N B_N.$$

Likewise, from the equation (3.12)

$$D_{T_N}B_N = -0.\,(-\sin(t)\,,\cos(t)\,,0)\,.$$

Here if we write τ_N and N_N values to their places

$$D_{T_N}B_N = -\tau_N N_N$$

will be found out. So, The correlations at (2.5) will be satisfied as a concu-lussion of Theorem 5. ■

If Darboux vector of the spherical indicatrix curve (N) is W_N, since

$$W_N = N_N \wedge D_{T_N}N_N$$

we get

$$W_N = \left(0,0,\frac{m}{n}\right). \tag{27}$$

Theorem 7 *For spherical indicatrix curve (N) there are such λ and μ values which satisfiy $N' + \lambda N'' + \mu N''' = 0$:*

$$\lambda = 0 \qquad \text{and} \qquad \mu = \frac{-m^2}{n^2}.$$

Proof. If we calculate the derivative of (3.10) to t_N

$$\begin{aligned} N'' &= \frac{m^2}{n^2}(\cos(t), -\sin(t), 0) \\ N''' &= \frac{m^2}{n^2}(-\sin(t), -\cos(t), 0) \end{aligned}$$

are found. If we replace these in the equation $N' + \lambda N'' + \mu N''' = 0$ we find. ■

Let $\{T_B(t), N_B(t), B_B(t)\}$ be the Frenet frame of the spherical indicatrix curve (B) of Salkowski curve

$$\begin{aligned} T_B &= \left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right) \\ N_B &= (\cos(t), \sin(t), 0) \\ B_B &= \left(n\sin(t), -n\cos(t), \frac{n}{m}\right) \end{aligned} \tag{28}$$

Graphs of the curves are like to be in figure 2.a). Actually, if the derivative of the vector

$$\begin{aligned} B(t) = &(n\cos(nt)\sin(t) - n\cos(t)\sin(nt), -\cos(t)\cos(nt) \\ &-\sin(t)\sin(nt), \frac{n}{m}\cos(nt)) \end{aligned}$$

we will get

$$T_B = \frac{B'(t)}{\|B'(t)\|} = \left(\frac{n}{m}\sin(t), -\frac{n}{m}\cos(t), -n\right).$$

Since

$$B_B = \frac{B'(t) \wedge B''(t)}{\|B'(t) \wedge B''(t)\|}$$

we get

$$B_B = \left(n\sin(t), -n\cos(t), \frac{n}{m}\right)$$

and since

$$N_B = B_B \wedge T_B$$

we have

$$N_B = (\cos(t), \sin(t), 0).$$

Theorem 8 *If curvature is κ_B and torsion is τ_B of the spherical indicatrix (B),*

$$\kappa_B = \frac{1}{\sin(nt)} \qquad \text{and} \qquad \tau_B = -\frac{m}{\sin(nt)}. \tag{29}$$

Proof. If we find derivative of (B) to t_B,we have

$$T_B = \frac{dB}{dt}\frac{dt}{dt_B}.$$

Then we calculate the norms and have the equation and put the value $\tau = \tan(nt)$ to its places

$$\frac{dt}{dt_B} = \frac{m}{n\sin(nt)}.$$

If we calculate derivative of T_B in (3.14) to t_B, we will get

$$D_{T_B}T_B = \left(\frac{\cos(t)}{\sin(nt)}, \frac{\sin(t)}{\sin(nt)}, 0\right). \tag{30}$$

Graph of the curve is like to be in figure 2.e). Since

$$\kappa_B = \langle D_{T_B}T_B, N_B\rangle$$

we have

$$\kappa_B = \frac{1}{\sin(nt)}.$$

Likewise, if we find derivative of N_B in (3.14) to t_B, we will get

$$D_{T_B}N_B = \left(-\frac{m\sin(t)}{n\sin(nt)}, \frac{m\cos(t)}{n\sin(nt)}, 0\right). \tag{31}$$

Graph of the curve is like to be in figure 2.b). Since

$$\tau_B = \langle D_{T_B} N_B, B_B \rangle$$

we get

$$\tau_B = -\frac{m}{n \sin(t)}.$$

■

Theorem 9 *Frenet-Serret formulas of the spherical indicatrix curve* (B)

$$\begin{aligned} D_{T_B} T_B &= \left(\frac{\cos(t)}{\sin(nt)}, \frac{\sin(t)}{\sin(nt)}, 0 \right), \\ D_{T_B} N_B &= \left(-\frac{m \sin(t)}{n \sin(nt)}, \frac{m \cos(t)}{n \sin(nt)}, 0 \right) \\ D_{T_B} B_B &= \left(\frac{m \cos(t)}{\sin(nt)}, \frac{m \sin(t)}{\sin(nt)}, 0 \right) \end{aligned}$$

Proof. The statements $D_{T_B} T_B$ and $D_{T_B} N_B$ have been found in (3.16) and (3.19). If we find derivative of B_B at the statement (3.14) to t_B, we will get

$$D_{T_B} B_B = \left(\frac{m \cos(t)}{\sin(nt)}, \frac{m \sin(t)}{\sin(nt)}, 0 \right). \tag{32}$$

Graph of the curve is like to be in figure 2.e). ■

Besides, because of the equation (3.16), it will be

$$D_{T_B} T_B = \frac{1}{\sin(nt)} (\cos(t), \sin(t), 0).$$

If we write the value of κ_B in (3.15) and the value of N_B in (3.14) to their places from here ,we can get

$$D_{T_B} T_B = \kappa_B N_B.$$

Likewise from equation (3.17) we get

$$\begin{aligned} D_{T_B} N_B &= -\frac{1}{\sin(nt)} \left(\frac{n}{m} \sin(t), -\frac{n}{m} \cos(t), -n \right) \\ &\quad -\frac{m}{n \sin(nt)} \left(n \sin(t), -n \cos(t), \frac{n}{m} \right). \end{aligned}$$

Here, if we pay attention to (3.14) and (3.15), it will be

$$D_{T_B} N_B = -\kappa_B T_B + \tau_B B_B.$$

Likewise, we can write

$$D_{T_B} B_B = -\left(-\frac{m}{\sin(nt)}\right).(\cos(t), \sin(t), 0)$$

because of the equations (3.18). Here, If we write value of τ_B in (3.15) and value of N_B in (3.14)

$$D_{T_B} B_B = -\tau_B N_B$$

will be found. So, the correlations in (2.8) will be satisfied as a conculussion of Theorem 8.

If the Darboux vector of the spherical indicatrix curve (B) is W_B, since

$$W_B = N_B \wedge D_{T_B} N_B$$

we get

$$W_B = \left(0, 0, \frac{m}{n\sin(nt)}\right). \tag{33}$$

Theorem 10 *For spherical indicatrix curve (B) there are such λ and μ values which satisfiy $B' + \lambda B'' + \mu B''' = 0$:*

$$\begin{aligned}
\lambda &= \sin(t)\sin(nt). \\
&\left(\frac{\left(-\frac{\cos(t)}{\sin(nt)} + \frac{2\sin(t)\cos(nt)n}{\sin^2(nt)} + \frac{2\cos(t)\cos^2(nt)n^2}{\sin^3(nt)} + \frac{\cos(t)n^2}{\sin(nt)}\right)m}{n\sin(nt)} \right. \\
&\left. \frac{-\left(\frac{\sin(t)}{\sin(nt)} - \frac{\cos(t)\cos(nt)n}{\sin^2(nt)}\right)m\cos(nt)}{\sin^2(nt)} \right) \\
&+\cos(t)\sin(nt). \\
&\left(\frac{\left(-\frac{\sin(t)}{\sin(nt)} - \frac{2\cos(t)\cos(nt)n}{\sin^2(nt)} + \frac{2\sin(t)\cos^2(nt)n^2}{\sin^3(nt)} + \frac{\sin(t)n^2}{\sin(nt)}\right)m}{n\sin(nt)} \right. \\
&\left. \frac{-\left(\frac{\cos(t)}{\sin(nt)} - \frac{\sin(t)\cos(nt)n}{\sin^2(nt)}\right)m\cos(nt)}{\sin^2(nt)} \right)
\end{aligned}$$

and

$$\mu = \left(\frac{-\cos(t)\sin(nt)+\sin(t)\cos(nt)n}{n\sin(nt)}\right)\cdot \left(\begin{array}{c} \frac{\left(-\frac{\cos(t)}{\sin(nt)}+\frac{2\sin(t)\cos(nt)n}{\sin^2(nt)}+\frac{2\cos(t)\cos^2(nt)n^2}{\sin^3(nt)}+\frac{\cos(t)n^2}{\sin(nt)}\right)m^2}{n\sin(nt)} \\ -\frac{\left(-\frac{\sin(t)}{\sin(nt)}-\frac{\cos(t)\cos(nt)n}{\sin^2(nt)}\right)m^2\cos(nt)}{\sin^2(nt)} \end{array}\right) + \left(\frac{\sin(t)\sin(nt)-\cos(t)\cos(nt)n}{n\sin(nt)}\right)\cdot \left(\begin{array}{c} \frac{\left(-\frac{\sin(t)}{\sin(nt)}-\frac{2\cos(t)\cos(nt)n}{\sin^2(nt)}+\frac{2\sin(t)\cos^2(nt)n^2}{\sin^3(nt)}+\frac{\sin(t)n^2}{\sin(nt)}\right)m^2}{n\sin(nt)} \\ -\frac{\left(\frac{\cos(t)}{\sin(nt)}-\frac{\sin(t)\cos(nt)n}{\sin^2(nt)}\right)m^2\cos(nt)}{\sin^2(nt)} \end{array}\right).$$

Proof. If we calculate the derivative of (3.21) to t_B

$$B'' = \frac{m}{n\sin(nt)}\left(-\frac{\sin(t)}{\sin(nt)}-\frac{\cos(t)\cos(nt)n}{\sin^2(nt)}, \frac{\cos(t)}{\sin(nt)}-\frac{\sin(t)\cos(nt)n}{\sin^2(nt)}, 0\right)$$

$$B''' = \frac{m}{n\sin(nt)}\left(\begin{array}{c} \frac{\left(-\frac{\cos(t)}{\sin(nt)}+\frac{2\sin(t)\cos(nt)n}{\sin^2(nt)}+\frac{2\cos(t)\cos^2(nt)n^2}{\sin^3(nt)}+\frac{\cos(t)n^2}{\sin(nt)}\right)m}{n\sin(nt)} \\ -\frac{\left(-\frac{\sin(t)}{\sin(nt)}-\frac{\cos(t)\cos(nt)n}{\sin^2(nt)}\right)m\cos(nt)}{\sin^2(nt)}, \\ \frac{\left(-\frac{\sin(t)}{\sin(nt)}-\frac{2\cos(t)\cos(nt)n}{\sin^2(nt)}+\frac{2\sin(t)\cos^2(nt)n^2}{\sin^3(nt)}+\frac{\sin(t)n^2}{\sin(nt)}\right)m}{n\sin(nt)} \\ -\frac{\left(\frac{\cos(t)}{\sin(nt)}-\frac{\sin(t)\cos(nt)n}{\sin^2(nt)}\right)m\cos(nt)}{\sin^2(nt)}, 0 \end{array}\right)$$

are found. If we replace these in the equation $B' + \lambda B'' + \mu B''' = 0$ we find. ■

If the unit vector in the direction of Darboux vector W of Salkowki curve is C, we have

$$C(t)=\left(n\sin(t),-n\cos(t),\frac{n}{m}\right). \tag{34}$$

Let $\{T_C(t),N_C(t),B_C(t)\}$ be the Frenet frame of the spherical indicatrix curve $(C)=\alpha(t_C)=C(t)$ of Salkowski curve,

$$\begin{aligned} T_C &= (\cos(t),\sin(t),0) \\ N_C &= (-\sin(t),\cos(t),0) \\ B_C &= (0,0,1) \end{aligned} \tag{35}$$

Graphs of the curves are like to be in figure 2.a). Actually; if we find derivative of the vector

$$C(t)=\left(n\sin(t),-n\cos(t),\frac{n}{m}\right)$$

we get

$$T_C=\frac{C'(t)}{\|C'(t)\|}=(\cos(t),\sin(t),0).$$

Since

$$B_C=\frac{C'(t)\wedge C''(t)}{\|C'(t)\wedge C''(t)\|}$$

we have

$$B_C=(0,0,1)$$

and since

$$N_C=B_C\wedge T_C$$

we will get

$$N_C=(-\sin(t),\cos(t),0).$$

Theorem 11 *If curvature is κ_C and torsion is τ_C of the spherical indicatrix curve (C),*

$$\kappa_C=\frac{1}{n} \quad \text{and} \quad \tau_C=0. \tag{36}$$

Proof. If we calculate derivative of (C) to t_C,

$$T_C=\frac{dC}{dt}\frac{dt}{dt_C}.$$

Then we calculate the norms and have the equation

$$\frac{dt}{dt_C} = \frac{1}{n}.$$

If we find derivative of T_C in (3.21) to t_C , we will get

$$D_{T_C}T_C = \left(-\frac{\sin(t)}{n}, \frac{\cos(t)}{n}, 0\right). \tag{37}$$

Graph of the curve is like to be in figure 2.a). Since

$$\kappa_C = \langle D_{T_C}T_C, N_C\rangle$$

we get

$$\kappa_C = \frac{1}{n}.$$

If we find derivative of N_C in (3.21) to t_C,

$$D_{T_C}N_C = \left(-\frac{\cos(t)}{n}, -\frac{\sin(t)}{n}, 0\right) \tag{38}$$

will be found out. Graph of the curve is like to be in figure 2.a). Since

$$\tau_C = \langle D_{T_C}N_C, B_C\rangle$$

we can get

$$\tau_C = 0.$$

■

Theorem 12 *Frenet-Serret formulas of the spherical indicatrix curve* (C)

$$\begin{aligned} D_{T_C}T_C &= \left(-\frac{\sin(t)}{n}, \frac{\cos(t)}{n}, 0\right) \\ D_{T_C}N_C &= \left(-\frac{\cos(t)}{n}, -\frac{\sin(t)}{n}, 0\right) \\ D_{T_C}B_C &= (0,0,0) \end{aligned}$$

Proof. The statements $D_{T_C}T_C$ and $D_{T_C}N_C$ have been found in (3.22) and (3.23). If we find derivativeof B_C in (3.21) to t_C, we will get

$$D_{T_C}B_C = (0,0,0)\,. \tag{39}$$

■

Besides, If we write values of κ_C in (3.22) and N_C in (3.21) at statement

$$D_{T_C}T_C = \frac{1}{n}\left(-\sin(t)\,,\cos(t)\,,0\right).$$

we can get

$$D_{T_C}T_C = \kappa_C N_C.$$

Likewise, we can write

$$D_{T_C}N_C = -\frac{1}{n}\left(\cos(t)\,,\sin(t)\,,0\right) - 0.\left(-\sin(t)\,,\cos(t)\,,0\right)$$

from the statement (3.24). Here, if we pay attention to the statements (3.21) and (3.22)

$$D_{T_C}N_C = -\kappa_C T_C + \tau_C B_C$$

will it be. Likewise, we can write

$$D_{T_C}B_C = \frac{1}{n}.\,(0,0,0)\,.$$

Here, if we write the values of τ_C in (3.22) and N_C in (3.21) to their places, we can get

$$D_{T_C}B_C = -\tau_C N_C.$$

So, as a conculussion of the Theorem 11. the correlations

$$\begin{aligned} D_{T_C}T_C &= \kappa_C N_C \\ D_{T_C}N_C &= -\kappa_C T_C + \tau_C B_C \\ D_{T_C}B_C &= -\tau_C N_C \end{aligned}$$

If the Darboux vector of the spherical indicatrix curve (C) is W_C, since,

$$W_C = N_C \wedge D_{T_C} N_C$$

we have

$$W_C = \left(0, 0, \frac{1}{n}\right). \tag{40}$$

Theorem 13 *For spherical indicatrix curve (C) there are such λ and μ values which satisfiy $C' + \lambda C'' + \mu C''' = 0$:*

$$\lambda = 0 \qquad \text{and} \qquad \mu = 0.$$

Proof. If we calculate the derivative of (3.23) to t_C

$$C'' = \left(-\frac{\cos(t)}{n^2}, -\frac{\sin(t)}{n^2}, 0\right)$$

$$C''' = \left(\frac{\sin(t)}{n^3}, -\frac{\cos(t)}{n^3}, 0\right)$$

are found. If we replace these in the equation $C' + \lambda C'' + \mu C''' = 0$ we find.

■

4.Arc Lenghts of Spherical Indicatrix Curves of Salkowski Curve

If the arc lenght for (T) is s_T it is

$$s_T = \int_0^t \left\| \frac{dT}{dt} \right\| dt = \int_0^t \frac{n}{m} \cos(nt)\, dt,$$

$$s_T = \int_0^t \frac{1}{\|W_T\|} dt \tag{41}$$

or from (3.1)

$$s_T = \int_0^t \|W\| \cos(nt)\, dt. \tag{42}$$

If the arc lenght for (N) is s_N it is

$$s_N = \int_0^t \left\| \frac{dN}{dt} \right\| dt = \int_0^t \frac{n}{m} dt,$$

$$s_N = \int_0^t \frac{1}{\|W_N\|} dt \tag{43}$$

or

$$s_N = \int_0^t \|W\| \, dt. \tag{44}$$

If the arc lenght for (B) is s_B it is

$$s_B = \int_0^t \left\| \frac{dB}{dt} \right\| dt = \int_0^t \frac{n}{m} \sin(nt) \, dt,$$

$$s_B = \int_0^t \frac{1}{\|W_B\|} dt \tag{45}$$

or

$$s_B = \int_0^t \|W\| \sin(nt) \, dt. \tag{46}$$

If the arc lenght for (C) is s_C it is

$$s_C = \int_0^t \left\| \frac{dC}{dt} \right\| dt$$

$$s_C = \int_0^t \frac{1}{\|W_C\|} dt \tag{47}$$

or

$$s_C = \int_0^t n dt. \tag{48}$$

5.Geosedic Curvetures of Spherical Indicatrix Curves of Salkowski Curve

Let find the geosedic curvetures of (T), (N), (B) and (C) to E^3. Let's say the of curve (T) parameter is t_T and tangent vector is T_T. Supposing that of the (T) geodesic curveture is k_T , we get

$$k_T = \|D_{T_T} T_T\| = \frac{1}{\cos(nt)},$$

$$k_T(t) = \|W(t)\|. \tag{49}$$

Let me say the parameter is t_N and the tangent vector is T_N of the curve (N). Supposing that k_N is the geodesic curveture of (N) at E^3 , we will get

$$k_N = \|D_{T_N} T_N\| = \frac{m}{n},$$

$$k_N(t) = \frac{1}{\|W(t)\|}. \tag{50}$$

Let me say the parameter is t_B and the tangent vector is T_B of the curve (B). Supposing that k_B is the geodesic curveture of (B) at E^3 , we will get

$$k_B = \|D_{T_B} T_B\|,$$

$$k_B(t) = \frac{1}{\sin(nt)}. \tag{51}$$

Let me say the parameter is t_C and the tangent vector is T_C of the curve (C). Supposing that k_C is the geodesic curveture of (C) at E^3 , we will get

$$k_C = \|D_{T_C} T_C\|,$$

$$k_C(t) = \frac{1}{n}. \tag{52}$$

Let's find the geosedic curvetures of (T), (N), (B) and (C) to S^2. Supposing that the geodesic curveture for (T) is γ_T , it is $\gamma_T = \left\|\overline{D}_{T_T} T_T\right\|$ .Because $\langle S_{T_T}, T_T\rangle = 1$ at the statement $\overline{D}_{T_T} T_T = D_{T_T} T_T + \langle S_{T_T}, T_T\rangle T$ it will be

$$\overline{D}_{T_T} T_T = D_{T_T} T_T + T$$

where

$$\begin{aligned}\overline{D}_{T_T}T_T &= \tan(nt)\cos(t)\sin(nt) - n\sin(t)\cos(nt), \\ &\quad \sin(t)\sin(nt) + n\cos(t)\cos(nt), -\frac{n}{m}\cos(nt))\end{aligned}$$

will be found out. Then,

$$\gamma_T = \tan(nt) \tag{53}$$

will be achived. Likewise, supposing that the geodesic curveture for (N) is γ_N , it is $\gamma_N = \left\|\overline{D}_{T_N}T_N\right\|$ .Because $\langle S_{T_N}, T_N\rangle = 1$ at the statement

$\overline{D}_{T_N}T_N = D_{T_N}T_N + \langle S_{T_N}, T_N\rangle N$ it will be

$$\overline{D}_{T_N}T_N = D_{T_N}T_N + N$$

where

$$\overline{D}_{T_N}T_N = \left(\frac{n^2-m^2}{mn}\sin(t), -\frac{n^2-m^2}{mn}\cos(t), -n\right)$$

will be found out. Then,

$$\gamma_N = m = \frac{n}{\|W(t)\|} \tag{54}$$

will be achieved. Likewise, supposing that the geodesic curveture for (B) is γ_B , it is $\gamma_B = \left\|\overline{D}_{T_B}T_B\right\|$ .Because $\langle S_{T_B}, T_B\rangle = 1$ at the statement
$\overline{D}_{T_B}T_B = D_{T_B}T_B + \langle S_{T_B}, T_B\rangle B$ it will be

$$\overline{D}_{T_B}T_B = D_{T_B}T_B + B$$

where

$$\begin{aligned}\overline{D}_{T_B}T_B &= \frac{1}{\tan(nt)}\cos(t)\cos(nt) + n\sin(t)\sin(nt), \\ &\quad \sin(t)\cos(nt) - n\cos(t)\sin(nt), \frac{n}{m}\sin(nt)) \\ \overline{D}_{T_B}T_B &= -\frac{1}{\tau}T\end{aligned}$$

will be found out. Then,

$$\gamma_B = \frac{1}{\tau} = \frac{1}{\tan(nt)} \tag{55}$$

will be achived. Likewise, supposing that the geodesic curveture for (C) is γ_C , it is $\gamma_C = \left\| \overline{D}_{T_C} T_C \right\|$ .Because $\langle S_{T_C}, T_C \rangle = 1$ at the statement $\overline{D}_{T_C} T_C = D_{T_C} T_C + \langle S_{T_C}, T_C \rangle C$ it will be

$$\overline{D}_{T_C} T_C = D_{T_C} T_C + C$$

where

$$\overline{D}_{T_C} T_C = \frac{1}{m} \left(-\frac{n \sin(t)}{m}, \frac{n \cos(t)}{m}, n \right)$$

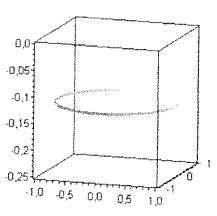
will be found out. Then,

$$\gamma_C = \frac{1}{m} = \frac{1}{n} \left\| W(t) \right\| \tag{56}$$

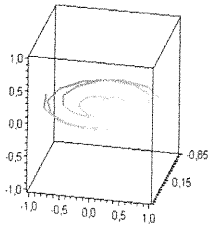
So, this theorem can be considered :

Theorem 14 *Geodesic curvetors of (T), (N), (B) and (C) spheric indicator curves which belong to frenet vectors of salkowski curve to E^3 and S^2 are, respectively;*

$1 - k_T(t) = \left\| W(t) \right\|$, $k_N(t) = \frac{1}{\left\| W(t) \right\|}$, $k_B(t) = \frac{1}{\sin(nt)}$, $k_C(t) = \frac{1}{n}$,
$2 - \gamma_T = \tan(nt)$, $\gamma_N = \frac{n}{\left\| W(t) \right\|}$, $\gamma_B = \frac{1}{\tan(nt)}$, $\gamma_C = \frac{1}{n} \left\| W(t) \right\|$.



a)



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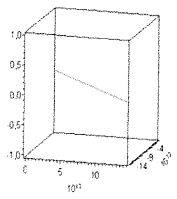
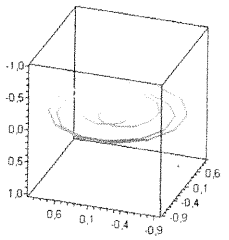
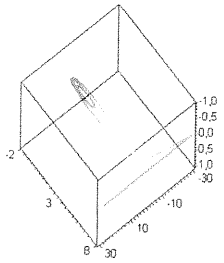


c)



d)



e)

Figure 2.Some Spherical indicatrix of Salkowski curves with $\kappa = 1$ *for*

$$m = \frac{1}{8},\ \textit{plotted for}\ t\epsilon\left[-\frac{\pi}{2n}, \frac{\pi}{2n}\right].$$

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ROLE OF AVOGADRO NUMBER IN GRAND UNIFICATION

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'N' being the Avogadro number it is suggested that strong nuclear gravitational constant (G_S) is N^2 times the classical gravitational constant (G_C). (G_S) plays a vital role in strong interaction and nuclear space-time curvature. This new subject can be termed as 'strong nuclear gravity'. Based on strong nuclear gravity and super symmetry it is noticed that $\hbar$ is a secondary physical constant. Previously proposed 2 strong interaction fermions rest masses revised to 105.3226825 MeV and 11460.81321 MeV. Previously proposed super symmetry fermion-boson mass ratio is revised to 2.262218404. Nuclear charge radius, mole radius and gram mole are discussed. Charged lepton rest masses fitted accurately. New heavy charged lepton is predicted at 42262 MeV. Up and down quark mass ratio is equal to $\sin\theta_W$. Quark masses, QCD scale, nucleons rest masses, strong coupling constant, Fermi's weak coupling constant and semi empirical mass formula energy constants are fitted. It can be suggested that top quark boson and electroweak $W^{\pm}$ charged

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boson both are same. Z^0 boson constitutes 2 oppositely charged higg's bosons or it constitutes one $W^{\pm}$ and gluonic form of charged higg's boson. Third alternative is that the new heavy charged lepton pair transforms into a pair of neutral boson having a neutral mass $2\left(\frac{42262}{2.262}\right) \cong 37.364$ GeV and makes the Z^0 with $\sin\theta_W \cos\theta_W$ as usual. Finally it can be suggested that nuclear and particle physics can be studied in the view of 'strong nuclear gravity' and super symmetry.

Keywords:grand unification; super symmetry; Avogadro number; strong nuclear gravity; classical gravitational constant; strong nuclear gravitational constant; electromagnetic mass unit; quark-lepton-nuclear mass generator; strong coupling constant; $\hbar$; QCD scale; Fermi's weak coupling constant ; proton and neutron rest masses; electroweak bosons; Charged Higg's boson; semi empirical mass formula; gram mole.

1 Introduction

Unification means : finding the similarities, finding the limiting physical constants, finding the key numbers, coupling the key physical constants, coupling the key physical concepts, coupling the key physical properties, minimizing the number of dimensions, minimizing the number of inputs and implementing the key physical constant or key number in different branches of physics. This is a very lengthy process. In all these cases observations, interpretations, experiments and imagination play a key role. The main difficulty is with interpretations and observations. As the interpretation changes physical concept changes, physical equation changes and finally the destiny changes. In developing a model the utmost important things are self confidence, strong initiative, believing in something, believing in others opinions, believing in observations, believing in experiments, believing in physical limits and finally believing in maths. Neutrally and friendly if one is able to believe in all these aspects, certainly a simplified model can be generated. Universe is a very big laboratory and its life span is very large. Any thing may happen at any time. Modern physics is having only and

hardly 200 years of strong scientific back ground. Often physicists and field experts say- this is conventional, that is unconventional etc. It only depends upon reasoning, understanding, analyzing and applying. Strong motivation, good reasoning, nature friendly concepts, simplicity and applicability are the most favorable and widely accepted qualities of any new model.

Note that in the atomic or nuclear physics, till today no one measured the gravitational force of attraction between the proton and electron and experimentally no one measured the value of the gravitational constant. Physicists say, if strength of strong interaction is unity, with reference to the strong interaction, strength of gravitation is 10^{-39}. The fundamental question to be answered is: is mass an inherent property of any elementary particle? To unify 2 interactions if 5 dimensions are required, for unifying 4 interactions 10 dimensions are required. For 3+1 dimensions if there exists 4 (observed) interactions, for 10 dimensions there may exist 10 (observable) interactions. To unify 10 interactions 20 dimensions are required. It seems this is a mathematical problem rather than a serious fundamental physical problem. Seshavatharam and Lakshminarayana modified the super symmetry concepts and introduced the new strong nuclear gravity concepts [1,2,3,4,5,6,7,8]. In this paper an attempt is made to understand the mystery of higg's and electroweak physics. In particle physics, super symmetry (often abbreviated SUSY) is a symmetry that relates elementary particles of one spin to other particles that differ by half a unit of spin and are known as super partners. In a theory with unbroken super symmetry, for every type of boson there exists a corresponding type of fermion with the same mass and internal quantum numbers, and vice-versa. So far, there is only indirect evidence for the existence of super symmetry. Here in this context Seshavatharam and Lakshminarayana [1] introduced the following new concepts in the year 2010.

1) In super symmetry fermion and its corresponding boson masses are not equal.

2) For every fermion there exists a corresponding boson of mass equal to $\frac{mass\ of\ fermion}{\Psi}$ where Ψ is a number having a value close to 2.262 but not unity.

1.1 Journey towards strong nuclear gravity

As the culmination of his life work, Einstein wished to see a unification of gravity and electromagnetism as aspects of one single force. In modern language he wished to unite electric charge with the gravitational charge (mass) into one single entity. Further, having shown that mass the 'gravitational charge? was connected with space-time curvature, he hoped that the electric charge would likewise be so connected with some other geometrical property of space-time structure. For Einstein the existence, the mass, the charge of the electron and the proton the only elementary particles recognized back in 1920s were arbitrary features. One of the main goals of a unified theory should explain the existence and calculate the properties of matter ([9],[10],[11],[12],[13],[14],[15],[16],[17]). Considering space-time curvature concepts charged particle's mass generation can be given as

$$\frac{e^2}{4\pi\epsilon_0 R_X} \cong \sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{c^4}{G_C}\right)} \cong M_X c^2. \tag{1}$$

where G_C is the classical gravitational constant, e is the elementary charge, R_X and M_X can be represented as the size and mass of a generated charged massive particle. The most important observation is that $\frac{c^4}{G_C}$ is having the dimensions of 'force'. It was clearly discussed by Seshavatharam [18] and the same was discussed at planck vacuum by Daywitt [19]. Recalling Einstein's view that 'unification of gravity and electromagnetism as aspects of one single force' it suggests that this large magnitude of force play some interesting role in toe, grand unification and general theory of relativity. In general theory of relativity, this expression appears as $\frac{8\pi G_C}{c^4}$. Particle's mass can be given as

$$M_X \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G_C}}. \tag{2}$$

Its characteristic size can be given as

$$R_X \cong \sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{G_C}{c^4}\right)}. \tag{3}$$

Qualitatively this obtained mass unit play some role in the generation of elementary particle's rest mass. But from numerical point of view this mass

is very large compared to the observed elementary particle's rest mass. To bring down the planck mass scale to the observed elementary particles mass scale a large scale factor is required. By any suitable reason if one is able to increase the value of classical gravitational constant, it helps in three ways. Observed elementary particles mass can be generated and nuclear space time curvature can be understood. Third important application is - no extra dimensions are required. Finally nuclear physics can be studied in the view of 'strong nuclear gravity' where nuclear charge and strong nuclear gravitational constant play a crucial role in the nuclear space-time curvature, QCD and quark confinement. In this new direction Seshavatharam and Lakshminarayana published the papers [1,2,3,4]. Lepton masses, quark masses, baryon masses, meson masses are fitted and predicted. Nucleon masses fitted. Extending this work to nuclear physics, nuclear size, semi empirical mass formula energy constants are fitted. The strange and important outcome of this work is that $\hbar$ is a secondary physical constant.

2 5 assumptions in strong nuclear gravity

The 5 important assumptions are

1. N being the Avogadro number strong gravitational constant G_S is N^2 times the classical gravitational constant G_C.
2. There exists 2 strongly interacting fermions of rest energy $M_{Sf}c^2 \cong 105.3226825\ MeV$ and $M_{Gf}c^2 \cong 11460.81321\ MeV$ in such a way that $(11460.8)^{\frac{7}{15}}\,(105.32)^{\frac{8}{15}} \cong 939.6\ MeV$. (105 MeV fermion plays a crucial role in nuclear physics and 11460 MeV fermion plays a crucial role in quark-gluon physics).
3. In super symmetry fermion, boson mass ratio is $\Psi \cong 2.262218404$ (but not unity).
4. There exists nature friendly integral charge quark fermions and integral charge quark bosons. There exists integral charged massive quark fermi-gluons and integral charged massive quark boso-gluons. (Fermi-gluon means massive gluons having fermion behavior and boso-gluon means massive gluons having boson behavior).
5. $\hbar$ is a secondary or derived physical constant. Like 'e' it is not an in-

dependent physical constant. Note that this is an optional assumption in strong nuclear gravity.

2.1 The strong nuclear gravitational constant (G_S)

It is assumed that, the nuclear space-time curvature is due to the nuclear charge and the strong nuclear gravitational constant (G_S) . G_S is assumed as

$$G_S \cong N^2\, G_C \cong 2.420509614 \times 10^{37}\ \ N.m^2/Kg^2. \tag{4}$$

Here, G_C= classical or cosmic gravitational constant $\cong 6.6742867 \times 10^{-11}$ $N.m^2/Kg^2$. N = *Avogadro number*. Mohar and Taylor [20] recommended a value of $N \cong 6.022141793 \times 10^{23}$. Till now Avogadro number is a mystery. Carlo Avogadro [21] published his hypothesis in 1811.'Why there are N atoms in a mole' is still a less answer question. Authors wish to say that, existence of the classical gravitational constant (G_C) is a consequence of the existence of the strong nuclear gravitational constant (G_S) . Another possibility is that both G_C and G_S can be considered as the 'head' and 'tail' of the (matter) coin. Bohr radius and corresponding potential energy of electron in hydrogen atom can be represented by

$$a_0 \cong \frac{2E_a}{E_c}\sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{G_S}{c^4}\right)}. \tag{5}$$

$$\frac{e^2}{4\pi\epsilon_0 a_0} \cong \frac{E_c}{2E_a}\sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{c^4}{G_S}\right)} \cong \alpha^2 m_e c^2. \tag{6}$$

Here, $E_a \cong 23.21\ MeV$ = asymmetry energy constant, $E_c \cong 0.71\ MeV$ = columbic energy constant of the semi empirical mass formula respectively. Note that $\frac{2E_a}{E_c}$ plays a crucial role in nuclear stability. From these 2 equations one can understand the significance of the proposed strong nuclear gravitational constant.

2.2 β decay and rest mass of electron

From equation (6) and considering $\beta-$ decay, rest mass of electron can be estimated. At this moment a modern physicist can not admit this idea.

Their view is that this large value of G can not be incorporated in the GTR or existing physics. This is absolutely true. Here the very important question to be answered is- which is more fundamental, either G_C or N^2G_C? It is well known that celestial bodies constitutes so may electrons and nucleons. Clearly speaking mass of the celestial body is an index of how many nucleons it constitutes. The subject of unification is broad in the sense it makes an attempt to understand the origin of mass generation of elementary particles. In this situation one can confidently say - the existing gravitational constant G_C is a consequence of grand unification. Not only that the mysterious concept gram mole can be understood very easily. In the charge-mass unification program or grand unified program G is large and works for the construction of the massive elementary particles. One may believe or may not believe, this is a strange fact. 'At one go' a grand unified model may not be developed. In this paper authors proposed many interesting and strange relations. No doubt these ideas are against to the existing physical concepts but authors confidently say, 'final unification' is not far away from reality. Rest mass of electron can be given as

$$m_e \cong \frac{1}{\alpha^2}\,\frac{E_c}{2E_a}\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}}. \tag{7}$$

It is known that in β decay electron is instantaneously coming out from the nucleus. From this proposed expression it can be suggested that $\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}}$ is the basic 'electromagnetic mass' unit and α^2, $\frac{E_c}{2E_a}$ can be considered as the quantum mechanical stability constants in strong nuclear gravity. To prove this equation experimentally one must search for the existence of a massive electromagnetic particle having mass $\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}}$. Experimentally one can not measure the value N^2G_C. Indirectly its significances in different areas of physics has to be explored. Alternative idea is one must believe in the existence of N^2G_C and move further. This is a very sensitive problem.

2.3 Elementary charge, strong nuclear gravitational constant, Avogadro number and the nuclear charge radius

The first estimate of a nuclear charge radius was made by Hans Geiger and Ernest Marsden [22] in 1909, under the direction of Ernest Rutherford at the Physical Laboratories of the University of Manchester, UK. The famous experiment involved the scattering of $\alpha-$ particles by gold foil, with some of the particles being scattered through angles of more than 90^o, that is coming back to the same side of the foil as the $\alpha-$ source. Later studies found an empirical relation between the charge radius and the mass number, A, for heavier nuclei $A \geq 20$,

$$R_A \cong R_0 A^{1/3}. \tag{8}$$

where R_0 is an empirical constant of 1.2 to 1.5 fm. In semi empirical mass formula its empirical value is close to 1.25 fermi. It is assumed that,

$$2\pi R_C \cong \frac{1}{\ln(N^2)} \sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{G_S}{c^4}\right)}. \tag{9}$$

where R_C is the nuclear charge radius, N is the Avogadro number and $\ln(N^2) \cong \ln\left(\frac{G_S}{G_C}\right)$. This equation can be given a chance in understanding the nuclear space-time curvature. It can be suggested that, elementary charge (e), Avogadro number and the proposed (G_S) plays a vital role in strong interaction and nuclear space time curvature. With these expressions one can say that R_C is a characteristic length in strong nuclear gravity.

$$R_C \cong \frac{1}{2\pi \ln(N^2)} \sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{G_S}{c^4}\right)} \cong 1.208398568 \times 10^{-15}\, meter. \tag{10}$$

This idea is very similar to Schwarzschild radius of black hole. Schwarzschild radius of an object is proportional to the mass. But in case of a nucleon or elementary particle how they are acquiring mass, is a mysterious problem. Here it can be suggested that nuclear charge radius can be compared with Schwarzschild radius of black hole. Due to quantum mechanical (tunneling) effects particles are escaping from the nuclear surface. Please see the

following strange relation.

$$R_C \cong \frac{1}{N^2}\left(\frac{\hbar c}{G_C m_e^2}\right)^2 \frac{2G_C m_e}{c^2} \cong \frac{2\hbar^2}{(N^2 G_C)\, m_e^3} \cong \frac{2\hbar^2}{G_S m_e^3}. \tag{11}$$

Here m_e is the rest mass of electron and $\frac{2G_C m_e}{c^2}$ is nothing but the black hole radius of electron. This equation plays a crucial role in implementing the classical gravitational constant G_C in atomic physics. This is a very strange, superb and accurate expression that couples the micro-macro physical constants. One can not deny its existence in the grand unification program. Considering the super symmetry of strong interaction its full meaning can be understood. Value of R_C or G_C or N or G_S can be accurately estimated from this expression. Surprisingly it is also noticed that

$$R_C \cong \frac{1}{N^2}\, e^{\frac{M_{Sf}}{m_e}}\, \frac{2G_C m_e}{c^2}. \tag{12}$$

Here $M_{Sf} \cong 105.32\ MeV/c^2$ is the proposed new mass unit. As a consequence it is noticed that,

$$\left(\frac{\hbar c}{G_C m_e^2}\right)^2 \cong e^{\frac{M_{Sf}}{m_e}}. \tag{13}$$

How to interpret this equation? Most interesting question is : Why it is coinciding like this? If field experts show interest authors hope that it will not be a big problem to resolve the mystery of 'grand unification'.

2.4 Introduction of 'electromagnetic mass unit'

The very important observation is that gravity and electromagnetism can be coupled via the concepts of 'electromagnetic mass' and 'gravitational mass'. It can be suggested that for any observable elementary particle its 'gravitational mass' and 'electromagnetic mass' ratio is equal to $X_E \cong 295.0606338$. Till today there exists two kinds of masses. They are gravitational mass and inertial mass. From now onwards one can think about three masses, namely electromagnetic, gravitational and inertial masses. This idea can be applied to leptons as well as hadrons. $\sqrt{\frac{e^2c^4}{4\pi\epsilon_0 G_S}} \cong 0.0017318\ MeV$ can be

considered as the basic electromagnetic mass unit. It plays a crucial role in generating the rest mass of any elementary particle. Clearly speaking it is more fundamental than the Higg's particle. It is the grand unified mass unit. Surprising thing is that its mass is very close to the neutral neutrino mass.

2.5 Quark-lepton-nuclear mass generator X_E

It is noticed or defined that

$$\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}} \cong 3.087291597 \times 10^{-33}\ kg \cong 1.731844 \times 10^{-3}\ MeV/c^2. \quad (14)$$

This mass unit is roughly 295 times smaller than the electron rest mass. This can be called as the 'basic electromagnetic mass'. This couples gravity with electromagnetism. Electron rest energy can be defined as

$$m_e c^2 \cong X_E \sqrt{\frac{e^2 c^4}{4\pi\epsilon_0 G_S}}. \quad (15)$$

Here X_E is a number and can be called as quark-lepton-nuclear mass generator. In the previous paper Seshavatharam and Lakshminarayana [1] showed the role of X_E in quarks mass generation. Nucleons mass can be generated. Nuclear binding energy constants can be fitted. To obtain this number one must explore the structure of charged leptons. From strong coupling constant α_s and semi empirical mass formula energy constants this number can be obtained. For the time being it is defined as

$$X_E \cong N \sqrt{\frac{4\pi\epsilon_0 G_C m_e^2}{e^2}} \cong \sqrt{\frac{4\pi\epsilon_0 G_S m_e^2}{e^2}} \cong 295.0606338 \cong \frac{1}{\alpha^2}\left(\frac{E_c}{2E_a}\right). \quad (16)$$

Note that (α^2) is a grand unified super symmetric coupling constant. It will be discussed in the foregoing sections.

2.6 Charged lepton rest masses

Using this number charged lepton masses can be fitted as

$$m_l c^2 \cong \left[X_E^3 + \left(n^2 X_E\right)^n \sqrt{N}\right]^{\frac{1}{3}} \sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}} \cong \frac{2}{3}\left[E_c^3 + \left(n^2 X_E\right)^n E_a^3\right]^{\frac{1}{3}}. \quad (17)$$

Here n= 0,1, 2. E_c and E_a are the columbic and asymmetric energy constants of the semi empirical mass formula. Qualitatively this expression is connected with β deacy. See the following table-1. If electron mass is fitting at n = 0, muon mass is fitting at n = 1 and tau mass is fitting at n = 2 it is quite reasonable and natural to predict a new heavy charged lepton at n = 3. Electron was discovered in 1897. Muon was discovered in 1937. Tau was detected in a series of experiments between 1974 and 1977. Positron predicted in 1928 and discovered in 1936. The antiproton and antineutron were only postulated in 1931 and 1935 respectively and discovered in 1956. The charged pion was postulated in 1935 and discovered in 1947 and the neutral pion was postulated in 1938 and discovered in 1950. The 6 quarks were proposed and understood in between 1964 and 1977. By selecting the proper quantum mechanical rules if one is able to confirm the existence of the number n = 3, existence of the new lepton can be understood. At this moment one can not deny this prediction. Recent experiments suggests that there exists a 4th flavor neutrino. This can be considered as a base for the existence of the 4th charged lepton. At the same time one must critically examine the proposed relation for its nice and accurate fitting of the 3 observed charged leptons. Unfortunately inputs of this expression are new for the standard model. Hence one can not easily incorporate this expression in standard model. Till now in SM there is no formula for fitting the lepton masses accurately. It seems that there is something missing from the SM. Very interesting prediction is that at n=3 there may exist a heavy charged lepton at 42262 MeV. It is noticed that with super symmetry fermion-boson mass ratio 2.262 it transforms into a charged boson of mass $\left(\frac{42262}{2.262}\right) \cong 18681.85$ MeV. Surprisingly it is noticed that its pair mass is $2\left(\frac{42262}{2.262}\right) \cong 37363.63$ MeV. This is matching with the electroweak potential.

3 New strongly interacting nuclear fermion 105.32 MeV

It is assumed that strongly interacting fermion $M_{Sf}c^2 \cong 105.3226825$ MeV plays a vital role in nuclear physics. In quantum chromo dynamics (QCD),

n	Obtained Lepton mass, MeV	Exp. Lepton Mass, MeV
0	Defined	0.510998922
1	105.951	105.658369
2	1777.384	1776.84 ±0.17
3	42262.415	to be discovered

Table 1: Fitting of charged lepton rest masses.

the quantity Λ is called the QCD scale. Its value is $\Lambda_{MS} = 217^{+25}_{-23}$ MeV. Note that this is roughly twice of the proposed 105 MeV. Note that this mass unit is greater than the up and down quark masses and close to the strange quark mass. From the previous paper and with the revised value of $X_E \cong 295.0606338$ the revised quark masses can be given as $Uc^2 \cong 4.4\ MeV$, $Dc^2 \cong 9.4755\ MeV$, $Sc^2 \cong 152.5427\ MeV$, $Cc^2 \cong 1313.796\ MeV$, $Bc^2 \cong 5287.579\ MeV$ and $Tc^2 \cong 182160.18\ MeV$. Geometric mean of these 6 quarks is $(UDSCBT)^{1/6} c^2 \cong 447.672\ MeV$. The most surprising observation is that geometric mean of 105.32 MeV and 447.67 MeV is $\sqrt{105.32 * 447.67} \cong 217.14\ MeV$. Qualitatively and quantitatively this is matching with the QCD's $\Lambda_{MS} = 217^{+25}_{-23}$ MeV. This coincidence helps in 3 ways. First one is 'existence of 105.32 MeV fermion' can be confirmed. Second one is 'proposed method of quark mass estimation' can be confirmed. Third one is 'QCD scale can be coupled with strong nuclear gravity'.

Strong interaction is mediated by 105.32 MeV fermion and its super symmetric boson of rest energy $\frac{M_{Sf}c^2}{\psi} \cong \frac{105.32}{2.262218404} \cong 46.55\ MeV$. Using 105.32 MeV fermion nuclear charge radius can be fitted. Mole radius and mole volume can be understood. Proton, neutron rest masses can be fitted. Semi empirical mass formula energy constants can be fitted. Finally $\hbar$ can be fitted. Strong coupling constant α_s can be fitted. Glasman [23] discussed about α_s precision measurment. Erler and Langacker [24] discussed about the strong coupling constant. Chris Quigg discussed [25] about the estimation of Fermi's weak coupling constant. Empirically it is noticed that

$$\left[k^2 - k - X_E\right] \sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}} \cong 105.3224284\ MeV. \tag{18}$$

where $k \cong X_E - \ln(N) + \sqrt{\ln(N)} \cong 247.7053891$. Authors are working in

this new direction also. This equation may be helpful in understanding the origin of 105 MeV. This expression is nowhere used in this paper.

3.1 Fermi's weak coupling constant and bohr radius

Empirically Fermi's weak coupling constant F_W can be fitted as

$$F_W \cong \left(\frac{\alpha^2}{2}\right)\left(m_e c^2\right)\left(\frac{\hbar}{M_{Sf}c}\right)^3 \cong \left(\frac{m_e}{M_{Sf}}\right)\left(\frac{e^2}{4\pi\epsilon_0 M_{Sf}c^2}\right)^2\left(\frac{\hbar c}{2}\right). \quad (19)$$

$$F_W M_{Sf}^3 \cong \left(\frac{e^2}{4\pi\epsilon_0}\right)^2 \frac{\hbar m_e}{2c^3}. \quad (20)$$

Note that nucleon rest mass is not taking any role in this equation. This equation dierectly confirms the existence of $M_{Sf}c^2$.

From meticulous analysis, $G_F \cong \frac{F_W}{(\hbar c)^3} \cong 1.166371 \times 10^{-5}\ GeV^{-2}$ and $F_W \cong 1.435841042 \times 10^{-62}\ J.m^3$. Hence $M_{Sf}c^2 \cong 105.2675803\ MeV$. Since F_W is inversely proportional to M_{Sf}^3 it is very sensitive to obtain or fit the value of either F_W or M_{Sf}. From muon decay $G_F \cong \frac{F_W}{(\hbar c)^3} \cong 1.1638 \times 10^{-5}\ GeV^{-2}$ and from tau decay $G_F \cong \frac{F_W}{(\hbar c)^3} \cong 1.1642 \times 10^{-5}\ GeV^{-2}$.

It is also noticed that 'total energy of electron' in hydrogen atom is

$$\left(\frac{\alpha^2}{2}\right)\left(m_e c^2\right) \cong F_W \left(\frac{\hbar}{M_{Sf}c}\right)^{-3}. \quad (21)$$

Note that $\frac{\hbar}{M_{Sf}c} \cong 1.863547\ fermi$ can be compared with the strong interaction range. In this equation 'left hand side' is nothing but the 'total energy of electron' in hydrogen atom. This is a very simple and strange relation! Based on the unification of strong and weak interactions 'bohr radius' of hydrogen atom can be given as

$$a_0 \cong \left(\frac{e^2}{8\pi\epsilon_0}\right)\left(\frac{\hbar}{M_{Sf}c}\right)^3\left(\frac{1}{F_W}\right). \quad (22)$$

These ideas suggests that existence of the proposed strongly interacting $M_{Sf}c^2$ seems to be true and can be considered for further analysis positively. Its existence strongly supports the existence of the proposed strong nuclear gravitational constant G_S.

3.2 Nuclear charge radius and one mole radius

If $M_{Sf}c^2 \cong 105.3226825\ MeV$ it is noticed that

$$R_C \cong \left(\frac{1}{N}\right)^{\frac{1}{3}} \left[\frac{2G_S M_{Sf}}{c^2}\right] \cong 1.197574673 \times 10^{-15}\ meter. \tag{23}$$

$$\left[\frac{2G_S M_{Sf}}{c^2 R_C}\right]^3 \cong N = Avogadro\ number. \tag{24}$$

This expression seems to be very interesting. In this way, the proposed strong interaction fermion 105.32 to 105.33 MeV, strong gravitational constant G_S and Avogadro number play a crucial role in nuclear space-time curvature. By measuring the nuclear charge radius, value of $M_{Sf}c^2$ can be estimated. For getting accuracy the nuclear charge radius must be measured upto 20 decimal places.

3.3 One mole radius and one mole volume

More clearly saying,

$$R_M \cong \frac{2G_S M_{Sf}}{c^2} \cong 1.0113 \times 10^{-7}\ meter. \tag{25}$$

can be called as the 'one mole radius'. Very interesting idea is that, in a volume of $\frac{4\pi}{3}R_M^3$ there exists N nucleons. Hence

$$\frac{4\pi}{3}R_M^3 \cong \frac{4\pi}{3}\left(\frac{2G_S M_{Sf}}{c^2}\right)^3 \cong N\frac{4\pi}{3}R_C^3. \tag{26}$$

can be called as 'one mole volume'.

3.4 Mystery of $\hbar$ and the fine structure ratio

The utmost important and strange observation is

$$\sqrt{e^{\frac{M_{Sf}c^2}{m_e c^2}}} \times \frac{G_C m_e^2}{c} \cong \hbar. \tag{27}$$

$M_{Sf}c^2 \cong 105.32$ *to* $105.33\ MeV$ is the assumed strongly interacting fermion. From grand unification point of view this observation is very interesting. Authors wish to say that this is not an accidental coincidence. From this equation one can suggest that compared to $\hbar$, $M_{Sf}c^2$ is fundamental or primary. Planck-Einstein quantum relation or Bohr's discrete angular momentum relation only suggests that there exists basic quanta of energy or quanta of angular momentum. There must be some reason for this basic quanta. If it is assumed that electron is the utmost fundamental elementary particle and $M_{Sf}c^2 \cong 105.32\ MeV$ is the fundamental strongly interacting fermion, considering this expression it can be suggested that $\hbar$ is a secondary physical constant in 'strong nuclear gravity'. With reference to electron's gravitational and electromagnetic force ratio it can be expressed as

$$\frac{4\pi\epsilon_0 G_C m_e^2}{e^2} \times \sqrt{e^{\frac{M_{Sf}c^2}{m_e c^2}}} \times \frac{e^2}{4\pi\epsilon_0 c} \cong \hbar. \tag{28}$$

$$\left(\frac{X_E^2}{N^2}\right) \times \sqrt{e^{\frac{M_{Sf}c^2}{m_e c^2}}} \times \frac{e^2}{4\pi\epsilon_0 c} \cong \hbar. \tag{29}$$

Fine structure ratio can be given as

$$\frac{4\pi\epsilon_0 G_C m_e^2}{e^2} \times \sqrt{e^{\frac{M_{Sf}c^2}{m_e c^2}}} \cong \frac{1}{\alpha}. \tag{30}$$

It can be suggested that both quantum mechanics and quantum gravity are branches of strong nuclear gravity. Now a days field experts are trying to quantize gravity. Now the case is reverse. This new subject can be called as 'strong nuclear gravity'. Authors request the science community to kindly consider this idea for critical analysis. Considering these equations as granted, (i.e. $\hbar$ is a secondary physical constant), value of $M_{Sf}c^2$ can be estimated as 105.3226825 MeV accurately.

4 Applications of super symmetric fermion-boson mass ratio Ψ

4.1 Super symmetry of $M_{Sf}c^2$

In the previous published papers Seshavatharam and Lakshminarayana [1,2,3,4] proposed a strongly interacting fermion of energy $M_{Sf}c^2 \cong 105.3226824\ MeV.$ From super symmetry point of view its boson mass can be given as

$$M_{Sb}c^2 \cong \frac{M_{Sf}c^2}{\Psi} \cong \frac{105.3226824}{\Psi} \cong 46.557\ MeV. \tag{31}$$

where $\Psi = \ln\left(6+\sqrt{13}\right) \cong 2.264312$ is the proposed super symmetric fermion, boson mass ratio. Surprisingly it is noticed that

$$\frac{\sqrt{M_{Sf}M_{Sb}}}{m_e} \cong \frac{1}{\alpha}. \tag{32}$$

If this is not an accidental coincidence, using this equation if M_{Sf} is known Ψ can be estimated. With reference to fine structure ratio and electron rest mass its revised value is 2.262218404. Interesting idea is that, effective mass of $M_{Sf}c^2$can be given as

$$M_{Sfe}c^2 \cong \left(1-\frac{1}{\Psi}\right) M_{Sf}c^2 \cong 58.765\ MeV. \tag{33}$$

$M_{Sf}c^2$ and $M_{Sfe}c^2$ both play an interesting role in fitting the magnetic moments of proton and neutron. It was discussed by Seshavatharam and Lakshminarayana [1].

4.2 Super symmetry and the mystery of $\hbar$

In super symmetric strong nuclear gravity it can be suggested that

$$\hbar \cong \frac{1}{X_E}\sqrt{\left(\frac{e^2}{4\pi\epsilon_0 c}\right)\left(\frac{G_S M_{Sf}M_{Sb}}{c}\right)}. \tag{34}$$

Note that X_E and G_S are appearing in this equation and represents the role of strong nuclear gravity in unification. Interesting thing is that both M_{Sf}, M_{Sb} jointly plays a crucial role in generating the basic quanta of angular momentum. Now with reference to $\hbar$ value of Ψ can be given as 2.262218404.

$$\hbar c \cong \sqrt{\left(\frac{e^2}{4\pi\epsilon_0}\right)\left[G_S\left(\frac{M_{Sf}}{X_E}\right)\left(\frac{M_{Sb}}{X_E}\right)\right]}. \tag{35}$$

Note that in quantum theory of light, energy of photon is estimated from the excited electron. Note that photon is a boson and electron is a fermion. At the same time theory is considering fermion as well as a boson where the coupling unit is $\hbar$. Till now nobody knows the reason for the fundamental question, being a fermion, why electron emits and absorbs photon (which is a boson)? In this sensitive, critical and unknown situation above proposed idea can be given a chance in applying the super symmetry in understanding the basic concepts of unification. Fine structure ratio can be given as

$$\alpha^2 \cong \frac{e^2}{4\pi\epsilon_0 G_S}\left(\frac{X_E}{M_{Sf}}\right)\left(\frac{X_E}{M_{Sb}}\right). \tag{36}$$

Here, note that $\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}}$ can be considered as the basic electromagnetic mass of matter. $\left(\frac{M_{Sf}}{X_E}\right)$ and $\left(\frac{M_{Sb}}{X_E}\right)$ can be considered as the electromagnetic mass units of M_{Sf} and M_{Sb} respectively. Please note that this proposed expression is independent of the famous quantum constant $\hbar$. α^2 is the ratio of coulombic and gravitational force ratio of the electromagnetic mass units of M_{Sf} and M_{Sb} having charge e where the operating gravitational constant is having a value $N^2 G_C$. This expression clearly indicates the role of 'electromagnetic' mass unit in strong nuclear gravity or grand unification program.

4.3 Super symmetry and Fermi's weak coupling constant F_W

From equation (20) eliminating $\hbar$ and m_e and considering super symmetry, F_W can be given as

$$F_W \cong \left(\frac{1}{2}\right)\left(\frac{e^2}{4\pi\epsilon_0 M_{Sf}c^2}\right)^3\left(\frac{M_{Sf}c^2}{\sqrt{\Psi}}\right) \cong \left(\frac{1}{2}\right)\left(\frac{e^2}{4\pi\epsilon_0 M_{Sf}c^2}\right)^3\sqrt{M_{Sf}M_{Sb}}\,c^2. \tag{37}$$

Both M_{Sf}, M_{Sb} jointly plays a crucial role in the origin of F_W. Interesting idea is that, just like the classical radius of electron, $\left(\frac{e^2}{4\pi\epsilon_0 M_{Sf}c^2}\right)$ can be considered as the classical radius of the proposed $M_{Sf}c^2$. Considering this equation it can be suggested that $M_{Sf}c^2$ plays a crucial role in electroweak physics. If $M_{Sf}c^2 \cong 105.3226825\ MeV$, $F_W \cong 1.433588631 \times 10^{-62}\ J.m^3$ and $G_F \cong \frac{F_W}{(\hbar c)^3} \cong 1.164541308 \times 10^{-5}\ GeV^{-2}$.

5 Strong coupling constant α_s and the weak coupling angle $\sin\theta_W$

Strong coupling constant can be defined as

$$\alpha_s \cong \left[\ln\sqrt{\frac{2G_S M_{Sf}^2}{\hbar c}}\ \right]^{-1} \cong 0.112333685 \cong \frac{1}{\ln\left[X_E^2\sqrt{\alpha}\right]} \cong 0.11218006. \tag{38}$$

This expression clearly suuggests the combined role of proposed G_S and $M_{Sf}c^2$ in nuclear and particle physics. Note that $\frac{2G_S M_{Sf}^2}{\hbar c} \cong \left(\frac{2G_S M_{Sf}}{c^2}\right)\left(\frac{cM_{Sf}}{\hbar}\right)$. How to interpret this strange coincidence? Here $\frac{2G_S M_{Sf}}{c^2}$ can be considered as the black hole radius of M_{Sf} where the operating constant is G_S but not G_C. Similarly $\frac{\hbar}{cM_{Sf}}$ can be considered as the compton length of M_{Sf}. Inverse of α_s can be called as the strong interaction mass generator $= X_S$.

$$X_S \cong \ln\sqrt{\frac{2G_S M_{Sf}^2}{\hbar c}} \cong \frac{1}{\alpha_s} \cong \ln\left[X_E^2\sqrt{\alpha}\right] \cong 8.91423992. \tag{39}$$

This number plays a crucial role in nucleon mass generation, nuclear stability and fitting of binding energy constants. It plays crucial role in electroweak physics. It is noticed that

$$\ln\left[X_E^2\sqrt{\alpha}\right] \times M_{Sf}c^2 \cong X_S \times M_{Sf}c^2 \cong 938.8716604\ MeV. \tag{40}$$

This value is very close to the average mass of nucleon. This can be considered as the nuclear fermion. Excited levels can be given as

$$\left[n\left(n+1\right)\right]^{\frac{1}{4}} 939\ MeV \ \text{ and } \ \left[\frac{n\left(n+1\right)}{2}\right]^{\frac{1}{4}} 939\ MeV. \tag{41}$$

Here, n=1, 2, 3, ... Its corresponding super symmetric nuclear boson can be given as

$$\ln\left[X_E^2\sqrt{\alpha}\right] \times \frac{M_{Sf}c^2}{\Psi} \cong X_S \times M_{Sb}c^2 \cong 415.022\ MeV. \tag{42}$$

Excited levels can be given as

$$\left[n\left(n+1\right)\right]^{\frac{1}{4}} 415\ MeV \ \text{ and } \ \left[\frac{n\left(n+1\right)}{2}\right]^{\frac{1}{4}} 415\ MeV. \tag{43}$$

Here, n=1, 2, 3, ... In the previous paper Seshavatharam and Lakshminarayana [1] suggested and proved that 415 MeV boson is the mother of 493 MeV, 547 MeV, 892 MeV, 958 MeV and 1020 MeV strange mesons. Regge trajectory of some baryons and mesons can be understood in this way.

5.1 The weak coupling angle $\sin\theta_W$

It is noticed that the weak coupling angle can be related with strong nuclear gravity as

$$\sin\theta_W \cong \frac{1}{\alpha X_E} \cong 0.464433353 \cong \frac{U_f}{D_f}. \tag{44}$$

Here, α is the fine structure ratio and X_E is the lepton-quark-nuclear mass generator, U_f is up quark rest mass and D_f is down quark rest mass.

6 Integral charge quark super symmetry

Till today there is no reason for the question: why there exists 6 individual quarks? Till today no experiment reported a free quark. Authors humble opinion is nuclear charge (either positive or negative) constitutes 6 different flavors and each flavor holds certain mass. charged flavor can be called as a quark. It is neither a fermion nor a boson. A fermion is a container for different charges, a charge is a container for different flavors and each flavor is a container for certain matter. If charged matter rests in a fermionic container it is a fermion and if charged matter rests in a bosonic container it is a boson. The fundamental questions to be answered are : what is a charge? why and how opposite charges attracts each other? why and how there exists a fermion? and why and how there exists a boson? Here interesting thing is that if 6 flavors are existing with 6 different masses then a single charge can have one or two or more flavors simultaneously. Since charge is a common property, mass of the multiple flavor charge seems to be the geometric mean of the mass of each flavor. If charge with flavor is called as a quark then charge with multi flavors can be called as a hybrid quark. Hybrid quark generates a multi flavor baryon. It is a property of strong interaction space - time - charge. This is just like different tastes or different smells of matter. Important consequence of this idea is that- for generating a baryon there is no need to couple 3 fractional charge quarks.

In this paper Seshavatharam and Lakshminarayana tried to implement the super symmetry concepts in quark and sub quark physics. The basic idea is that for each and every quark fermion there exists a corresponding super symmetric quark boson. Proposed quark fermion and quark boson mass ratio is $\Psi \cong 2.262218404$. Obtained top quark boson mass is 80523 MeV and its assumed charge is $\pm e$. This is close to the $W^{\pm}$ mass (average with CERN UA2 data) = 80.454 ± 0.059 GeV. This may be a coincidence or there is some mystery behind the charged weak boson! In this way if one is able to predict the existence of (quark) bosons, there is no need to assume that any two quark fermions couples together to form a meson. Note that till today no experiment reported the existence of a fractional charge. Thus it can be interpreted that nature allows only integral charges. Hence it can be assumed that quark fermions and quark bosons possess unit charge. This

is the beginning of integral charge quark super symmetry.

Due to strong interaction there is a chance of coupling any two quark bosons. If any two oppositely charged quark bosons couples together then a neutral quark boson can be generated. It may be called as a neutral meson. Due to strong interaction by any chance if any quark boson couples with any quark fermion then a neutral baryon or baryon with can be generated. This idea is very similar to the photon absorption by electron. When a weakly interacting electron is able to absorb a boson, in strong interaction it is certainly possible. More over if a baryon couples with two or three quark bosons then the baryon mass increases and charge also changes. Here also if the system follows the principle 'unlike charges attracts each other' in most of the cases baryon charge changes from $\pm e$ to neutral and neutral to $\pm e$.

6.1 Estimation of the strongly interacting sub quark fermion $M_{Gf}c^2$ and boson $M_{Gb}c^2$

Seshavatharam and Lakshminarayana [1] proposed that there exists a strongly interacting fermion mass unit $M_{Gf}c^2 \cong 11450\ MeV$ in sub quark physics by using which quark gluon masses can be estimated. They proposed 4 empirical relations for fitting the value of $M_{Gf}c^2$. The fourth empirical relation seems to be simple and fitting well in estimating the average mass of nucleon. It is noticed that

$$M_{Gf}c^2 \cong [X_S\,(1-\sin\theta_W)]^3\ M_{Sf}c^2 \cong 11460.81321\ MeV, \qquad (45)$$

It's corresponding strongly interacting boson mass $M_{Gb}c^2$ can be given as

$$M_{Gb}c^2 \cong [X_S\,(1-\sin\theta_W)]^3\ \frac{M_{Sf}c^2}{\Psi} \cong \frac{M_{Gf}c^2}{\Psi} \cong 5066.183349\ MeV, \quad (46)$$

here, Ψ=proposed strong interaction fermion, boson mass ratio=2.26221840. Seshavatharam and Lakshminarayana showed the applications of these two mass units in particle physics [1]. $M_{Gf}c^2$ plays a crucial role in estimating the nucleons average rest mass and the strongly interacting effective quark fermi-gluonic masses.

6.2 Quark fermi-gluon and boso-gluon rest masses

In sub quark physics based on the proposed super symmetry concepts massive quark gluons having fermion behavior can be called as 'quark fermi-gluons' or 'quark baryons' and massive quark gluons having boson behavior can be called as 'quark boso-gluons' or 'quark mesons'. Their masses can be obtained as

$$Q_{Gf}c^2 \cong \left[\left(M_{Gf}c^2\right)^2 \times Q_f c^2\right]^{\frac{1}{3}}. \tag{47}$$

where Q_{Gf}=quark fermi-gluon mass and Q_f= quark fermion mass. $M_{Gb}c^2$ plays a crucial role estimating the strongly interacting boso-gluonic masses of quark bosons as

$$Q_{Gb}c^2 \cong \left[\left(M_{Gb}c^2\right)^2 \times Q_b c^2\right]^{\frac{1}{3}}. \tag{48}$$

where Q_{Gb}=quark boso-gluon mass and Q_b=quark boson mass. Effective quark fermi-gluons rest mass can be obtained as

$$Q_{Gfe}c^2 \cong \left[\left(M_{Gf}c^2\right)^2 \times Q_{fe}c^2\right]^{\frac{1}{3}}. \tag{49}$$

where Q_{Gfe}= effective quark fermi-gluon mass and $Q_{fe} \cong \left(1 - \frac{1}{\Psi}\right) Q_f$= effective quark fermion mass. Note that from proposed super symmetry concepts $\frac{Q_f}{\Psi} \cong Q_b$ is the corresponding quark boson.

6.3 Up and down quark fermi-gluons and rest energy of nucleons

Standard model assumes that nucleons constitutes up and down quarks. In quantum chromo dynamics, the modern theory of the nuclear force, most of the mass of the proton and the neutron is explained by special relativity. The mass of the proton is about eighty times greater than the sum of the rest masses of the quarks that make it up, while the gluons have zero rest mass. Note that $X_S^2 \cong 79.46367$. The extra energy of the quarks and gluons in a region within a proton, as compared to the energy of the quarks and

gluons in the QCD vacuum, accounts for over 98% of the mass. The internal dynamics of the proton are complicated, because they are determined by the quarks exchanging gluons, and interacting with various vacuum condensates. Lattice QCD provides a way of calculating the mass of the proton directly from the theory to any accuracy, in principle. The most recent calculations were performed by S.Durr et al [26]. They claim that the mass is determined to better than 4% accuracy, arguably accurate to 1%. Evidence that the proton is not typical also comes from B.G.sidharth [27].

These claims are still controversial, because the calculations cannot yet be done with quarks as light as they are in the real world. This means that the predictions are found by a process of extrapolation, which can introduce systematic errors. It is hard to tell whether these errors are controlled properly, because the quantities that are compared to experiment are the masses of the hadrons, which are known in advance. Compared to lattice QCD this proposed method of nucleons rest mass estimation is very simple and accurate. For up and down quarks their fermi-gluon masses can be given as

$$U_{Gf}c^2 \cong \left[(M_{Gf})^2 \times U_f\right]^{\frac{1}{3}} c^2 \cong 833.0140538\ MeV. \tag{50}$$

$$D_{Gf}c^2 \cong \left[(M_{Gf})^2 \times D_f\right]^{\frac{1}{3}} c^2 \cong 1075.66704\ MeV. \tag{51}$$

Here nucleons rest mass seems to lie in between up and down fermi-gluons rest mass. Authors showed the applications of quark fermi-gluons in estimating or fitting the baryons rest mass. Yao et al recommended [28] values are proton rest energy= $m_P c^2 = 938.272013$ MeV and neutron rest energy $= m_N c^2 = 939.565346$ MeV. Harmonic mean mass of up and down quark fermi-gluons can be given as

$$\left(\frac{2U_{Gf}D_{Gf}}{U_{Gf} + D_{Gf}}\right) c^2 \cong 938.9161598\ MeV. \tag{52}$$

Harmonic mean mass is coinciding with the average mass of nucleon = 938.9186795 MeV accurately! This may be the secret of origin of rest mass of nucleon. See the following table 2 and table 3 for the proposed quark family rest masses.

Seshavatharam and Lakshminarayana [1] suggested that up, strange and bottom quarks are in geometric series. Similarly down, charm and top

Quark	Q_{fe} MeV	Q_{Gfe} MeV
Up	$U_{fe} \cong 2.455 \cong 0.558 \times 4.4$	$U_{Gfe} \cong 685.78$
Down	$D_{fe} \cong 5.287 \cong 0.558 \times 9.4755$	$D_{Gfe} \cong 885.55$
Strange	$S_{fe} \cong 85.11 \cong 0.558 \times 152.5427$	$S_{Gfe} \cong 2236.01$
Charm	$C_{fe} \cong 733.04 \cong 0.558 \times 1313.796$	$C_{Gfe} \cong 4583.38$
Bottom	$B_{fe} \cong 2950.24 \cong 0.558 \times 5287.579$	$B_{Gfe} \cong 7290.59$
Top	$T_{fe} \cong 101637.37 \cong 0.558 \times 182160.18$	$T_{Gfe} \cong 23722.55$

Table 2: Proposed effective quark and effective quark fermi-gluon masses.

quarks are in another geometric series. H. Terazawa [29] proposed various relations for the quark masses.

$$U_f c^2 \cong e^{\alpha X_E}\, m_e c^2 \quad and \quad D_f c^2 \cong \alpha X_E\, U_f c^2. \tag{53}$$

Here $m_e c^2$ is the rest energy of electron. Proposed USB geometric ratio is

$$\left[\alpha X_E\, \frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 34.66294. \tag{54}$$

Proposed DCT geometric ratio is

$$\left[2\alpha X_E\, \frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 138.651754. \tag{55}$$

where ratio of DCT geometric ratio and USB geometric ratio is 4.

6.4 Neutron - proton mass difference

Harmonic mean mass of up and down quarks is

$$\left(\frac{2U_f D_f}{U_f + D_f}\right) c^2 \cong 6.010166458\ MeV. \tag{56}$$

It is noticed that

$$\left(\frac{U_f}{D_f}\right)^2 \times \left(\frac{2U_f D_f}{U_f + D_f}\right) c^2 \cong 1.296382928\ MeV \tag{57}$$

Quark	Q_b MeV	Q_{Gb} MeV
Up	$U_b \cong 1.945$	$U_{Gb} \cong 368.23$
Down	$D_b \cong 4.189$	$D_{Gb} \cong 475.49$
Strange	$S_b \cong 67.43$	$S_{Gb} \cong 1200.62$
Charm	$C_b \cong 580.756$	$C_{Gb} \cong 2461.04$
Bottom	$B_b \cong 2337.34$	$B_{Gb} \cong 3914.67$
Top	$T_b \cong 80522.81$	$T_{Gb} \cong 12737.76$

Table 3: proposed quark boson and quark boso-gluon masses.

This is close to the neutron-proton mass difference. It can be expressed as

$$\alpha^2 X_E^2 \left(m_N - m_P\right) c^2 \cong \frac{\left(m_N - m_P\right) c^2}{\sin \theta_W^2} \cong \left(\frac{2U_f D_f}{U_f + D_f}\right) c^2 \cong 6.0101665 \; MeV. \tag{58}$$

If this is true neutron rest energy can be given as $m_N c^2 \cong 939.5643513 \; MeV$ and proton rest energy can be given as $m_P c^2 \cong 938.2679683 \; MeV$.

7 Super symmetry and the mystery of electroweak charged boson $W^{\pm}$

Note that the obtained top quark fermion mass is 182160.18 MeV. Based on the proposed super symmetry concepts its corresponding top quark boson mass is

$$\left(T_b c^2\right)^{\pm} \cong \frac{T_f c^2}{\Psi} \cong \frac{182160.18}{2.262218404} \cong 80522.81 \; MeV. \tag{59}$$

Surprisingly this is matching with the presently believed electroweak charged boson having mass 80398 MeV. This clearly suggests that top quark boson is nothing but the electroweak charged boson. Authors request the science community to kindly look into this interesting issue. If this is really true it will be a big success for the super symmetry.

7.1 The Higg's charged boson $\left(M_{Hb}c^2\right)$ and the neutralized Z boson

In this section 3 methods are proposed for understanding the origin of Z^0 boson. Basic idea is that it is a neutralized particle and constitutes 2 oppositely charged bosons. Z^0 boson constitutes 2 oppositely charged higg's bosons or it constitutes one $W^{\pm}$ and gluonic form of charged higg's boson. Third alternative is that the new heavy charged lepton pair transforms into a pair of neutral boson having a neutral mass $2\left(\frac{42262}{2.262}\right) \cong 37.363$ GeV and makes the Z^0 with $\sin\theta_W \cos\theta_W$ as usual.

Method-1

Seshavatharam and Lakshminarayana [1] suggested that there exists a charged Higg's boson at $M_{Hb}c^2 \cong 45000\ MeV$. Two oppositely charged Higg's bosons couples together to form a neutralized Z boson of mass $\approx 90000\ MeV$. With the revised values $\left(M_{Hb}c^2\right)^{\pm}$ can be given as

$$\left(M_{Hb}c^2\right)^{\pm} \cong X_S \frac{M_{Gf}c^2}{\Psi} \cong X_S M_{Gb}c^2 \cong 45161.174\ MeV \tag{60}$$

With this idea, neutralized mass of Z^0 boson can be given as

$$\left(M_{Hb}c^2\right)^{\pm} + \left(M_{Hb}c^2\right)^{\mp} \cong 2 \times M_{Hb}c^2 \cong 90322.35\ MeV. \tag{61}$$

This can be compared with the experimental mass of Z^0 boson=91187 MeV.

Method-2

It is also noticed that charged Higg's boson transforms into strongly interacting gluonic boson as

$$\left(M_{Ghb}c^2\right)^{\pm} \cong \left[\left(M_{Gb}c^2\right)^2 \times M_{Hb}c^2\right]^{\frac{1}{3}}. \tag{62}$$

$$\left(M_{Ghb}c^2\right)^{\pm} \cong \left[5066.18^2 \times 45161.174\right]^{\frac{1}{3}} \cong 10504.51\ MeV. \tag{63}$$

By any chance if this Higg's boso-gluon couples with the proposed charged top quark boson= 80522 MeV neutralized mass of Z^0 boson can be given as

$$\left(T_b c^2\right)^{\pm} + \left(M_{GHb} c^2\right)^{\mp} \cong 80522.81 + 10504.51 \cong 91027.32\ MeV. \qquad (64)$$

This can be compared with the experimental mass of Z^0 boson=91187 MeV. Interesting points to be noted here are
1) There may exist a charged higg's boson at 45161.174 MeV.
2) There may exist a charged higg's boso-gluon at 10504.51 MeV.
3) There may exist a neutral higg's boso-gluon at 21009.0 MeV.
4) There may exist a neutral particle at 23242.28 MeV which is the sum of top quark boso-gluon and higg's charged boso-gluon.
5) There may exist a neutral top boso-gluon having mass equal to 25475.55 MeV.

Method-3

Seshavatharam and Lakshminarayana [2,3] predicted a new heavy charged lepton at 42260 MeV. If it is true that at high energies leptons acquires strong interaction behavior then based on the proposed new super symmetry fermion-boson mass factor $\Psi \cong 2.262218404$ for this new charged lepton its corresponding boson mass can be given as $\frac{42262.415}{\Psi} \cong 18681.85\ MeV.$ It is noticed that pair mass of this boson is equal to $2 \times 18681.85 \cong 37363.69 MeV.$ Surprisingly this is very close to electro weak potential 37.4 GeV. Really this is a strange coincidence. Now as usual with reference to the famous electro weak theory

$$\frac{37363.63}{\sin\theta_W} \cong \frac{37363.63}{0.464433353} \cong 80450.06\ MeV. \qquad (65)$$

where

$$\sin\theta_W \cong (\alpha X_E)^{-1} \cong 0.464433353. \qquad (66)$$

Here there is some twist. This 37363.63 MeV is a neutral particle where as $W^{\pm}$ is a charged particle. With reference to Z^0 boson this idea can be

supported. This obtained mass is very close to the experimental value of $W^{\pm}$.

$$\frac{37363.63}{\sin\theta_W \cos\theta_W} \cong \frac{80450.06}{0.88560807} \cong 90841.61\ MeV. \tag{67}$$

This can be compared with the experimental mass of Z^0 boson=91187 MeV. If this method is correct it directly indicates the existence of the fourth generation charged lepton at 42262 MeV. Not only that proposed super symmetry concepts can be confirmed. Proposed value of $\sin\theta_W$ seems to be very correct.

8 Proton-nucleon stability and nuclear binding energy

Proton-nucleon stability relation can be expressed as

$$A_S \cong 2Z + \frac{Z^2}{2X_S^2} \cong 2Z + \frac{Z^2}{158.927345}. \tag{68}$$

where $X_S \cong \frac{1}{\alpha_s} \cong \ln\left[X_E^2\sqrt{\alpha}\right] \cong 8.91423992$, Z is the proton number and A_S is the stable mass number. Roy Chowdhury et al [30] proposed a similar relation. By considering A as the fundamental input its corresponding stable Z $=Z_S$ can be obtained as

$$Z_S \cong \left[\sqrt{\frac{A}{158.927345} + 1} - 1\right] 158.927345. \tag{69}$$

Obtained data can be compared with the existing stability relation

$$Z_S \cong \frac{A}{2 + 0.0157A^{\frac{2}{3}}}. \tag{70}$$

See table-4 for the obtained stable mass numbers for Z=17 to 92.

Z	A_S	Round off A_S	Stable Isotope
17	35.82	36	35, 37
21	44.77	45	45
29	63.29	63	63, 65
39	87.57	88	89
47	107.90	108	107, 109
59	139.90	140	141
69	167.96	168	169
79	197.27	197	197
83	209.35	209	209
92	237.26	237	238

Table 4: Fitting of proton-nucleon stability.

8.1 Semi empirical mass formula binding energy constants

Let E_a = asymmetry energy constant, E_p = pairing energy constant, E_v = volume energy constant, E_s = surface energy constant and E_c = coulomb energy constant. W. D. Myers et al [31] generated the nuclear masses. Similarly G. Audi and A. H. Wapstra [32] estimted the atomic mases. In this paper it is suggested that in the semi empirical mass formula

$$E_p \cong \frac{M_{Sf}c^2}{X_S} \cong 11.81510521\ MeV. \tag{71}$$

$$E_a \cong 2E_p \cong \frac{2M_{Sf}c^2}{X_S} \cong 23.63021043\ MeV. \tag{72}$$

$$\frac{E_c}{2E_a} \cong \left(\alpha^2 X_E\right) \cong 0.0157124 \cong \frac{2R_C\left(m_N - m_P\right)c}{\hbar}. \tag{73}$$

This condition plays a key role in nuclear stability. See the existing nuclear stability relation (70). Hence $E_c \cong 0.7425736$ MeV.

$$E_s \cong \frac{E_a + E_p}{2} + \left[\alpha X_E\right] E_c \cong 19.3215387\ MeV. \tag{74}$$

$$E_v \cong \frac{E_a + E_p}{2} - \left[\alpha X_E\right] E_c \cong 16.12377893\ MeV. \tag{75}$$

Z	A	Obtained Be, MeV
26	56	488.79
44	100	860.97
50	118	1003.06
79	197	1553.38
92	238	1803.50
108	292	2097.54

Table 5: Fitting of nuclear binding energy with proposed energy constants.

$$E_a + E_p \cong E_v + E_s \cong 3E_p \cong 35.445315645\ MeV. \tag{76}$$

The semi empirical mass formula is

$$Be \cong AE_v - A^{\frac{2}{3}}E_s - \frac{Z(Z-1)}{A^{\frac{1}{3}}}E_c - \frac{(A-2Z)^2}{A}E_a \pm \frac{1}{\sqrt{A}}E_p. \tag{77}$$

See the following table-5.

9 Mystery of the gram mole

Authors humble opinion is - Avogadro number is not a pure number. Clearly speaking it is the square root of ratio of strong nuclear gravitational constant and the fclassical gravitational constant.

$$N \cong \sqrt{\frac{G_S}{G_C}}. \tag{78}$$

Here G_S= gravitational constant operating in the nuclear system,G_C = gravitational constant operating in the free space or universe and N = Avogadro number. In SI system of units why gram mole is being used? This fundamental question can be answered if it is assumed that there exists a limit for the quantum mechanical atomic mass. The definition of 'quantum mechanical atomic mass can be given as- it is the upper limit for the mass of an elementary particle or mass of a microscopic system or mass of an atom where in the existing quantum mechanical and atomic laws can

be applied. If mass of the system crosses the limit quantum mechanics and atomic structure transforms to classical physical laws. Quantitatively the assumed mass limit can be in obtained in the following way.

$$G_S m_p^2 \cong G_C M_X^2. \tag{79}$$

where G_S = operating gravitational constant in atomic physics, m_p = operating mass unit in atomic physics = mass of proton, G_C = operating gravitational constant in classical physics and M_X = operating mass unit in classical physics.

$$\left(\frac{M_X}{m_p}\right)^2 \cong N^2. \tag{80}$$

Hence $M_X \cong N \times m_p \cong 1.0072466 \times 10^{-3}\ Kg \cong 1.0072466\ gram$. In this way gram mole can be understood.

Conclusions

Proposed new ideas or relations collectively suggest that Avogadro number plays a crucial role in grand unification program. The most puzzling question is: how to prove this experimentally? Authors are working in this direction also. If field experts including experimental physicists show interest it will not be a big problem to understand the proposed relations. Alternative is- in different areas of physics it's significance has to be explored at utmost fundamental level. Significance of the 'electromagnetic mass' unit can be understood from the proposed relations. Super symmetry fermion-boson mass ratio can be considered as 2.2622 but not unity. Strongly interacting 105 and 11460 MeV fermions existence can be confirmed.

Note that human beings are part of this universal gravity. There are some natural restrictions to experiments. Seeing a black hole is highly speculative. But indirectly its significances can be well understood. In the similar way in nuclear and particle physics: any experimental setup which is being run under the influence of the proposed strong nuclear gravity, without knowing the probing particles massive origin, without knowing the massive origin of the nucleus: based on grand unified scheme one may not be able to unearth the absolute findings. Note that observer, experimental

setup and the probing particle all are under the same influence of universal gravity. When searching for an experimental proof in grand/final unification scheme this fact may be considered positively for further analysis. Authors request the world science community to kindly look into these new ideas for further analysis.

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INTERACTION OF SLIP AND CHEMICAL REACTION ON PERISTALTIC TRANSPORT OF A NEWTONIAN FLUID WITH VARIABLE VISCOSITY IN AN ASYMMETRIC VERTICAL CHANNEL

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Abstract

The effect of slip velocity and chemical reaction on the peristaltic transport of a Newtonian fluid with variable viscosity in an asymmetric vertical channel has been discussed. Asymmetry in the flow is induced due to traveling waves of different phase and amplitude which propagate along the channel walls. Long wavelength approximation is used for the flow analysis to obtain closed form analytic solution for the axial velocity, the concentration field and the pressure gradient. The pressure rise is computed numerically and explained graphically. The effects of slip parameter, Schmidt number, chemical reaction parameter, phase difference and local mass Grashof number on the pressure gradient, the pressure rise and the axial velocity are discussed. Moreover, the effects of Schmidt number, chemical reaction parameter and phase difference on the concentration distribution are discussed numerically and explained graphically.

Keywords: Peristalsis; Asymmetric channel; Slip condition; variable viscosity; Chemical reaction.
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1. Introduction

The study of the mechanism peristalsis, in both mechanical and physiological situations, has recently become the object of scientific research. The first mathematical attempt made to understand the peristaltic motion was done by Latham [14]. After that study, many models have been investigated by Shapiro et al.[18], Fung and Yih [8], Yih and Fung [23], Shukla and Gupta[19], Srivatava and Srivastava [20], and many others to describe peristaltic flow in an infinitely long two-dimensional symmetric channel or tube containing a Newtonian or non-Newtonian fluid.

The importance of the study of peristaltic transport in an asymmetric channel has been brought out by Eytan and Elad [7]. They have developed a mathematical model of wall-induced peristaltic fluid flow in a two-dimensional channel with wave trains having a phase difference moving independently on the upper and lower walls to simulate intra-uterine fluid motion in a sagittal cross-section of the uterus. Ebaid [3] investigated the effects of magnetic field and wall slip condition on the peristaltic transport of a Newtonian fluid in an asymmetric channel. Sobh [22] studied The effect of slip flow on peristaltic transport of a Carreau fluid in an asymmetric channel. Also, the influence of slip on peristaltic motion of a third order fluid in an asymmetric channel discussed by Hayat *et al.* [12]. Furthermore, Nadeem and Akram [17] discussed the slip effects on the peristaltic flow of a Jeffrey fluid in an a symmetric channel under the effect of induced magnetic field. Mishra and Ramachandra Rao [15] have investigated the

flow in an asymmetric channel generated by peristaltic waves propagating on the walls with different amplitudes and phase.

The fluid flow with variable viscosity has been studied by many authors. Elbarbary and Elgazery [5] have investigated the chebyshev finite difference method for the effects of variable viscosity and variable thermal conductivity on heat transfer from moving surfaces with radiation. Hayat and Ali [10] discussed the effect of variable viscosity on the peristaltic transport of a Newtonian fluid in an asymmetric channel. In his paper, A. Ebaid [4] studied a new numerical solution for the MHD peristaltic flow of a bio-fluid with variable viscosity in a circular cylindrical tube via a domain decomposition method. Also the peristaltic MHD of third grade fluid with an endoscope and variable viscosity is studied by Hayat et al. [11].

Recently, some studies have been done to understand the interaction of chemical reaction and fluid flow. Ghaly and Seddeek [9] analyzed the effect of variable viscosity, chemical reaction, heat and mass transfer on laminar flow along a semi-infinite horizontal plate. Hossain et al. [13] studied the influence of fluctuating surface temperature and concentration and natural convection flow from a vertical plate. Ahmed [2] studied the effects of the chemical reaction and viscous dissipation on unsteady combined heat and mass transfer along an infinite vertical porous plate in presence of a transverse magnetic field. More recently, Zueco and Ahmed [24] studied the combined heat and mass transfer by mixed convection MHD flow a long a porous plate with chemical reaction in presence of heat source. Furthermore, Nadeem

[16] discussed the simulation of heat and chemical reaction on Reiner Rivlin fluid model for blood flow through a tapered artery with a stenosis.

The purpose of the present study is to investigate the effects of variable viscosity and chemical reaction on peristaltic slip flow in an asymmetric vertical channel. Using long wavelength approximation, analytic solution for the axial velocity, the concentration field and the pressure gradient are obtained. Furthermore, numerical computations have been carried out for the pressure rise. Finally, the graphical results are plotted and discussed in detail for various interesting phenomena.

2. Formulation of the Problem

Consider the peristaltic flow of an incompressible Newtonian fluid with variable viscosity in an asymmetric channel of width $d_1 + d_2$. The flow is generated by a sinusoidal wave train moving with constant speed c along the channel walls. In a Cartesian coordinate system $(\bar{X}, \bar{Y})$ the shape of the walls are

$$\bar{h}_1(\bar{X},\bar{t}) = d_1 + a_1 \cos\left[\frac{2\pi}{\lambda}(\bar{X} - c\bar{t})\right], \quad \text{right hand side wall,} \qquad (1)$$

$$\bar{h}_2(\bar{X},\bar{t}) = -d_2 - a_2 \cos\left[\frac{2\pi}{\lambda}(\bar{X} - c\bar{t}) + \phi\right], \quad \text{left hand side wall,} \qquad (2)$$

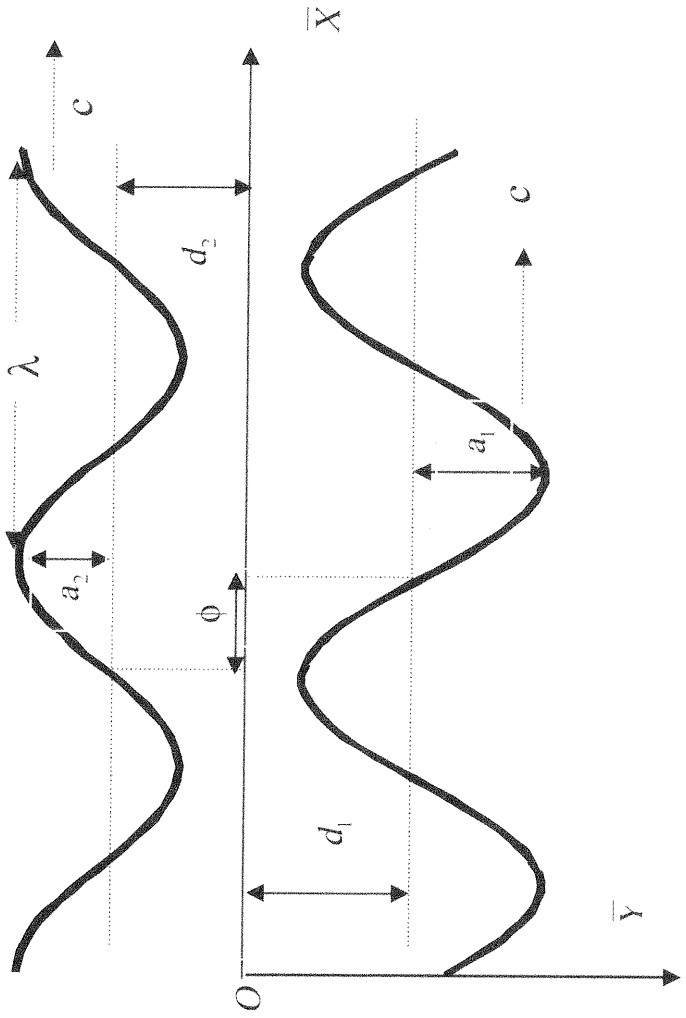

Fig.(1) Geometry of the problem

where a_1 and a_2 are the amplitudes of the waves, λ is the wavelength, c is the wave speed, t is the time and the phase difference ϕ varies in the range $0 \le \phi \le \pi$, ϕ =0 correspond to symmetric channel with waves out of phase and $\phi = \pi$ the waves are in phase, and further

a_1, a_2, d_1, d_2 and ϕ satisfies the condition $a_1^2 + a_2^2 + 2a_1 a_2 \cos\phi \le (d_1 + d_2)^2$. Let $(\overline{U}, \overline{V})$ be the velocity components in fixed frame of reference $(\overline{X}, \overline{Y})$.

It is assumed that the concentration at right hand side wall is C_1 and the concentration at the left hand side wall is C_2.

In the laboratory frame $(\overline{X}, \overline{Y})$ the flow is unsteady. However if observed in a coordinate system moving at wave speed c (wave frame) $(\overline{x}, \overline{y})$, it can be treated as steady. The coordinate frames are related in following

$$\overline{x} = \overline{X} - c\overline{t}, \qquad \overline{y} = \overline{Y}, \tag{3-a}$$

$$\overline{u} = \overline{U} - c, \qquad \overline{v} = \overline{V}, \tag{3-b}$$

in which $\overline{u}, \overline{v}$ are the velocity components in the wave frame.

The continuity, momentum and concentration equations are described by

$$\frac{\partial \overline{u}}{\partial \overline{x}} + \frac{\partial \overline{v}}{\partial \overline{y}} = 0, \tag{4}$$

$$\rho\left[\overline{u}\frac{\partial \overline{u}}{\partial \overline{x}} + \overline{v}\frac{\partial \overline{u}}{\partial \overline{y}}\right] = -\frac{\partial \overline{p}}{\partial \overline{x}} - 2\frac{\partial}{\partial \overline{x}}\left(\overline{\mu}(\overline{y})\frac{\partial \overline{u}}{\partial \overline{x}}\right) + \frac{\partial}{\partial \overline{y}}\left[\overline{\mu}(\overline{y})\left(\frac{\partial \overline{v}}{\partial \overline{x}} + \frac{\partial \overline{u}}{\partial \overline{y}}\right)\right] + \rho g B_c (C - \overline{C}), \tag{5}$$

$$\rho\left[\overline{u}\frac{\partial \overline{v}}{\partial \overline{x}} + \overline{v}\frac{\partial \overline{v}}{\partial \overline{y}}\right] = -\frac{\partial \overline{p}}{\partial \overline{y}} + 2\frac{\partial}{\partial \overline{y}}\left(\overline{\mu}(\overline{y})\frac{\partial \overline{v}}{\partial \overline{y}}\right) + \frac{\partial}{\partial \overline{x}}\left[\overline{\mu}(\overline{y})\left(\frac{\partial \overline{u}}{\partial \overline{y}} + \frac{\partial \overline{v}}{\partial \overline{x}}\right)\right] \tag{6}$$

$$\left[\overline{u}\frac{\partial C}{\partial \overline{x}} + \overline{v}\frac{\partial C}{\partial \overline{y}}\right] = D_m\left[\frac{\partial^2 C}{\partial \overline{x}^2} + \frac{\partial^2 C}{\partial \overline{y}^2}\right] - k_1 C \tag{7}$$

Where g is the acceleration due to gravity, C is the concentration of the fluid, $\overline{p}$ is the pressure, $\overline{\mu}(\overline{y})$ is the viscosity function, $\overline{C}$ is the mean value of C_1 and C_2, k_1 is the chemical reaction parameter, ρ is the

density, B_c is the coefficient of expansion with concentration and D_m is the coefficient of mass diffusivity.

Using the non-dimensional quantities

$$x = \frac{\bar{x}}{\lambda}, y = \frac{\bar{y}}{d_1}, u = \frac{\bar{u}}{c}$$

$$, v = \frac{\bar{v}}{c\delta}, t = \frac{c\bar{t}}{\lambda}, a = \frac{a_1}{d_1}, d = \frac{d_2}{d_1}, b = \frac{a_2}{d_1}, \delta = \frac{d_1}{\lambda},$$

$$\mu(y) = \frac{\bar{\mu}(\bar{y})}{\mu_0}, \mathrm{Re} = \frac{\rho c d_1}{\mu_0}, p = \frac{d_1^2 \bar{p}}{c\lambda\mu_0}, \Phi = \frac{C - \bar{C}}{C_1 - \bar{C}},$$

$$m = \frac{C_2 - \bar{C}}{C_1 - \bar{C}}, \quad S_c = \frac{\mu_0}{\rho D_m}$$

$$g_c = \frac{\rho g B_c (C_1 - \bar{C}) d_1^2}{\mu_0 c}, , h_1 = \frac{\bar{h}_1}{d_1}, h_2 = \frac{\bar{h}_2}{d_1}, \gamma = \frac{\rho k_1 d_1^2}{\mu_0}, \tag{8}$$

where Re is the Reynolds number, δ is the wave number, μ_0 is the viscosity, g_c is the local mass Grashof number, S_c is the Schmidt number and γ is the chemical reaction parameter, equation of continuity, momentum equations and concentration equation in wave frame, in non-dimensional form, are

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \tag{9}$$

$$\mathrm{Re}\delta\left[u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}\right] = -\frac{\partial p}{\partial x} + 2\delta^2 \frac{\partial}{\partial x}\left(\mu(y)\frac{\partial u}{\partial x}\right)$$

$$+ \frac{\partial}{\partial y}\left[\mu(y)\left(\delta^2 \frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)\right] + g_c \Phi \tag{10}$$

$$R_e \delta^3 \left[\left(u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}\right)\right] = -\frac{\partial p}{\partial y} + 2\delta^2 \frac{\partial}{\partial y}\left(\mu(y)\frac{\partial v}{\partial y}\right)$$

$$+\delta^2\frac{\partial}{\partial x}\left[\mu(y)\left(\frac{\partial u}{\partial y}+\delta^2\frac{\partial v}{\partial x}\right)\right], \qquad (11)$$

$$\mathrm{Re}\,\delta\left[u\frac{\partial\Phi}{\partial x}+v\frac{\partial\Phi}{\partial y}\right]=\frac{1}{S_c}\left(\delta^2\frac{\partial^2\Phi}{\partial x^2}+\frac{\partial^2\Phi}{\partial y^2}\right)-\gamma\Phi-c_1 \qquad (12)$$

Where $c_1=\dfrac{\rho k_1 d_1^2\overline{C}}{\mu_0(C_1-\overline{C})}$.

3. Rate of Volume Flow and Boundary Conditions

In laboratory frame, the dimensional volume flow rate is

$$Q=\int_{\bar{h}_2(\bar{X},\bar{t})}^{\bar{h}_1(\bar{X},\bar{t})}\overline{U}\left(\overline{X},\overline{Y},\bar{t}\right)d\overline{Y}, \qquad (13)$$

in which $\bar{h}_1$ and $\bar{h}_2$ are functions of $\overline{X}$ and $\bar{t}$. The above expression in the wave frame can be expressed as

$$q=\int_{\bar{h}_2(\bar{x})}^{\bar{h}_1(\bar{x})}\bar{u}(\bar{x},\bar{y})d\,\bar{y}, \qquad (14)$$

where $\bar{h}_1$ and $\bar{h}_2$ are functions of $\bar{x}$ only.

From Eqs. (3) , (13) and (14) we have

$$Q=q+c\bar{h}_1(\bar{x})-c\bar{h}_2(\bar{x}) \qquad (15)$$

The time- averaged flow over a period T at a fixed position $\overline{X}$ is

$$\overline{Q}=\frac{1}{T}\int_0^T Q\,d\,\bar{t} \qquad (16)$$

Substituting (15) into (16), and integrating, we get

$$\overline{Q}=q+cd_1+cd_2. \qquad (17)$$

Defining the dimensionless mean flows θ and F as follow

$$\theta=\frac{\overline{Q}}{cd_1}\text{ and }F=\frac{q}{cd_1}, \qquad (18)$$

equation (17) can be written as

$$\theta = F + 1 + d, \tag{19}$$

where

$$F = \int_{h_2(x)}^{h_1(x)} u dy. \tag{20}$$

We note that $h_1(x)$ and $h_2(x)$ represent the dimensionless forms of the wall surfaces and defined by

$$h_1(x) = 1 + a\cos 2\pi x \quad \text{and} \quad h_2(x) = -d - b\cos(2\pi x + \phi), \tag{21}$$

where $a = \frac{a_1}{d_1}$, $b = \frac{a_2}{d1}$, and $d = \frac{d_2}{d_1}$, and a, b, d and ϕ satisfy the relation

$$a^2 + b^2 + 2ab\cos\phi \le (1+d)^2. \tag{22}$$

The non-dimensional boundary conditions in the wave frame are

$$u = -1 - k_n \frac{\partial u}{\partial y} \qquad \text{at} \qquad y = h_1(x), \tag{23-a}$$

$$u = -1 + k_n \frac{\partial u}{\partial y} \qquad \text{at} \qquad y = h_2(x), \tag{23-b}$$

$$\Phi = 1 \qquad \text{at} \qquad y = h_1(x), \tag{24-a}$$

$$\Phi = m \qquad \text{at} \qquad y = h_2(x), \tag{24-b}$$

where $(k_n = \bar{k}_n / d_1)$ is the dimensionless slip parameter, $\bar{k}_n$ is the dimensional slip parameter.

4. Method of Solution

Using long wavelength $\delta << 1$ and low Reynolds number assumptions, Eqs.(9-12) tend to following system

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \tag{25}$$

$$0 = -\frac{\partial p}{\partial x} + \frac{\partial}{\partial y}\left[\mu(y)\left(\frac{\partial u}{\partial y}\right)\right] + g_c\Phi, \tag{26}$$

$$0 = -\frac{\partial p}{\partial y}, \tag{27}$$

$$0 = \frac{1}{S_c}\left(\frac{\partial^2 \Phi}{\partial y^2}\right) - \gamma \Phi - c_1. \tag{28}$$

In order to solve the above system analytically, we assume the variable viscosity of the fluid to be in the form [6,1,21].

$$\mu(y) = e^{-\alpha y}, \tag{29}$$

where α is the viscosity parameter, $\alpha << 1$.

Using the form (29) together with the boundary conditions (23-24) into Eqs. (26-28), we obtain the solution of the system in the form

$$\Phi(x,y) = A\,Cosh(\sqrt{S_c\gamma}\,y) + B\,Sinh(\sqrt{S_c\gamma}\,y) - \frac{c_1}{\gamma}, \tag{30}$$

$$u(x,y) = \left(\frac{\partial p}{\partial x}\right)\left[\frac{e^{\alpha y}(\alpha y - 1)}{\alpha^2}\right] - \frac{g_c A e^{\alpha y}}{\sqrt{S_c\gamma}}\left[\frac{\alpha \sinh\sqrt{S_c\gamma}\,y - \sqrt{S_c\gamma}\cosh\sqrt{S_c\gamma}\,y}{\alpha^2 - S_c\gamma}\right]$$

$$+\frac{g_c B e^{\alpha y}}{\sqrt{S_c\gamma}}\left[\frac{\alpha\cosh\sqrt{S_c\gamma}\,y - \sqrt{S_c\gamma}\sinh\sqrt{S_c\gamma}\,y}{\alpha^2 - S\gamma}\right] + \frac{g_c c_1}{\gamma}\left[\frac{e^{\alpha y}(\alpha y - 1)}{\alpha^2}\right]$$

$$+ G_1(x)\frac{e^{\alpha y}}{\alpha} + G_2(x), \tag{31}$$

where

$$A = \frac{\sinh\sqrt{S_c\gamma}\,h_2 - m\sinh\sqrt{S_c\gamma}\,h_1 + \frac{c_1}{\gamma}\left(\sinh\sqrt{S_c\gamma}\,h_2 - \sinh\sqrt{S_c\gamma}\,h_1\right)}{\cosh\sqrt{S_c\gamma}\,h_1\sinh\sqrt{S_c\gamma}\,h_2 - \cosh\sqrt{S_c\gamma}\,h_2\sinh\sqrt{S_c\gamma}\,h_1},$$

$$B = \frac{\cosh\sqrt{S_c\gamma}\,h_2 - m\cosh\sqrt{S_c\gamma}\,h_1 + \frac{c_1}{\gamma}\left(\cosh\sqrt{S_c\gamma}\,h_2 - \cosh\sqrt{S_c\gamma}\,h_1\right)}{\sinh\sqrt{S_c\gamma}\,h_1\cosh\sqrt{S_c\gamma}\,h_2 - \sinh\sqrt{S_c\gamma}\,h_2\cosh\sqrt{S_c\gamma}\,h_1},$$

$$G_1(x) = \frac{\alpha}{(b_5 + \alpha k_n b_6)}\left[\frac{\partial p}{\partial x}\left(\frac{\alpha a_5 + b_5 - k_n\alpha^2 a_6}{\alpha^2}\right) + \frac{g_c}{\sqrt{S_c\gamma}(\alpha^2 - S_c\gamma)}\left\{A\sqrt{S_c\gamma}\right.\right.$$

$$\left. - \alpha B)b_7 + (A\alpha + Ak_n(\alpha^2 - S_c\gamma) - B\sqrt{S_c\gamma})b_8 + Bk_n(\alpha^2 - S_c\gamma)a_7\right\}$$

$$\left. + \frac{g_c c_1}{\gamma}\left(\frac{\alpha a_5 + b_5 - k_n\alpha^2 a_6}{\alpha^2}\right)\right],$$

$$G_2(x) = -1 + \frac{1}{(b_5 + \alpha k_n b_6)}\left[\frac{\partial p}{\partial x}b_3\left(\frac{b_2 + 2k_n + \alpha^2 k_n^2 b_2}{\alpha}\right)\right.$$

$$\left. - \frac{g_c b_3}{\sqrt{S_c\gamma}(\alpha^2 - S_c\gamma)}\left\{A\sqrt{S_c\gamma} - B\alpha + Bk_n^2\alpha(\alpha^2 - S_c\gamma))b_9\right.\right.$$

$$+ (A\alpha - B\sqrt{S_c\gamma} - Ak_n^2\alpha(\alpha^2 - S_c\gamma))a_2 + (Bk_n\alpha\sqrt{S_c\gamma} - Ak_n S_c\gamma)a_3$$

$$\left. + (Ak_n\alpha\sqrt{S_c\gamma} - Bk_n S_c\gamma)a_4\right\} + \frac{g_c c_1}{\gamma\alpha}b_3\left(b_2 + 2k_n - \alpha^2 k_n^2 b_2\right)\Big], \qquad (32)$$

$$b_1 = e^{2\alpha h_1} + e^{2\alpha h_2}, b_2 = h_1 - h_2, b_3 = e^{\alpha(h_1+h_2)}, b_4 = e^{2\alpha h_1} - e^{2\alpha h_2},$$

$$b_5 = e^{\alpha h_1} - e^{\alpha h_2}, b_6 = e^{\alpha h_1} + e^{\alpha h_2},$$

$$b_7 = e^{\alpha h_2}\cosh\sqrt{S_c\gamma}h_2 - e^{\alpha h_1}\cosh\sqrt{S_c\gamma}h_1,$$

$$b_8 = e^{\alpha h_1}\sinh\sqrt{S_c\gamma}h_1 - e^{\alpha h_2}\sinh\sqrt{S_c\gamma}h_2,$$

$$b_9 = \cosh\sqrt{S_c\gamma}h_2 - \cosh\sqrt{S_c\gamma}h_1,$$

$$a_1 = -b_1 + \left[2 + \alpha^2 b_2\left(b_2 + 2k_n + \alpha^2 k_n^2 b_2\right)\right]b_3 - 2\alpha k_n b_4,$$

$$a_2 = \sinh\sqrt{S_c\gamma}h_1 - \sinh\sqrt{S_c\gamma}h_2,$$

$$a_3 = \sinh\sqrt{S_c\gamma}h_1 + \sinh\sqrt{S_c\gamma}h_2,$$

$$a_4 = \cosh\sqrt{S_c\gamma}\,h_1 + \cosh\sqrt{S_c\gamma}\,h_2, a_5 = h_2 e^{\alpha h_2} - h_1 e^{\alpha h_1},$$

$$a_6 = h_1 e^{\alpha h_1} + h_2 e^{\alpha h_2},$$

$$a_7 = e^{\alpha h_1}\cosh\sqrt{S_c\gamma}\,h_1 - e^{\alpha h_2}\cosh\sqrt{S_c\gamma}\,h_2. \qquad (33)$$

The instantaneous volume flow rate F, is given by

$$F = \int_{h_2(x)}^{h_1(x)} u\,dy$$

$$= -\frac{\partial p}{\partial x}\left[\frac{2b_5 + \alpha a_5}{\alpha^3}\right] - \frac{g_c(A\sqrt{S_c\gamma} - B\alpha)}{\sqrt{S_c\gamma}(S_c\gamma - \alpha^2)^2}\left(\alpha b_7 + \sqrt{S_c\gamma}\,b_8\right)$$

$$+ \frac{g_c(B\sqrt{S_c\gamma} - A\alpha)}{\sqrt{S_c\gamma}(S_c\gamma - \alpha^2)^2}\left(\alpha b_8 + \sqrt{S_c\gamma}\,b_7\right) - \frac{g_c c_1}{\gamma}(2b_5 + \alpha a_5)$$

$$+ \frac{G_1(x)b_5}{\alpha^2} + G_2(h_1 - h_2). \qquad (34)$$

Making use of equations (32), (34) and solving for $\frac{dp}{dx}$, we get

$$\frac{dp}{dx} = \frac{1}{a_1}\left[(F + h_1 - h_2)\alpha^3(b_5 + \alpha k_n b_6) + \frac{g_c\alpha^2}{\sqrt{S_c\gamma}(\alpha^2 - S_c\gamma)}\left(\alpha^2\sqrt{S_c\gamma} + (\sqrt{S_c\gamma})^3\right)\right.$$

$$(Ab_5b_7 - Bb_4b_8) + 2\alpha S_c\gamma(Ab_5b_8 - Bb_4b_7)) + \frac{g_c\alpha^3 k_n b_6}{\sqrt{S_c\gamma}(\alpha^2 - S_c\gamma)}\left(2\alpha^2\sqrt{S_c\gamma}\right.$$

$$(Ab_7 - Bb_8) + \alpha(S_c\gamma + \alpha^2)(Ab_8 - Bb_7) - \frac{g_c k_n\alpha^2 b_5}{\sqrt{S_c\gamma}}(Ab_8 - Bb_7) +$$

$$\frac{g_c\alpha^2 b_2 b_3}{\sqrt{S_c\gamma}(\alpha^2 - S_c\gamma)}\left(A\sqrt{S_c\gamma} - \alpha B + k_n^2\alpha(\alpha^2 - S_c\gamma)B)b_9 + (A\alpha - \sqrt{S_C\gamma}B -\right.$$

$$k_n^2\alpha(\alpha^2 - S_c\gamma)A)a_2 + (Bk_n\alpha\sqrt{S_c\gamma} - k_nS_c\gamma\, A)a_3 + (Ak_n\alpha\sqrt{S_c\gamma} - k_nS_c\gamma\, B)a_4\,]. \tag{35}$$

The pressure rise can be obtained by integrating pressure gradient as

$$\Delta p = \int_0^1 \frac{dp}{dx}dx. \tag{36}$$

It is important to note that the results for the flow with constant viscosity can be recovered as a special case by taking $\mu(y)$=1 as

$$u = \frac{1}{2}\left(\frac{dp}{dx}\right)y^2 - \frac{g_cA}{S_c\gamma}Cosh(\sqrt{S_c\gamma}\,y) - \frac{g_cB}{S_c\gamma}Sinh(\sqrt{S_c\gamma}\,y) + \frac{g_cc_1}{2\gamma}y^2 + G_3y + G_4 \tag{37}$$

and

$$\frac{dp}{dx} = \frac{12(F + h_1 - h_2)(h_1 - h_2 - 2k_n)}{a_{11}} - \frac{6g_c(h_1 - h_2 - 2k_n)}{a_{11}(S_c\gamma)^{\frac{3}{2}}}\Big(\big[2 + k_nS_c\gamma(h_1 - h_2)\big]$$

$$\big[Bb_9 - Aa_2\big] + (h_1 - h_2)\sqrt{S_c\gamma}\big[Aa_4 + Ba_3\big]\Big) - \frac{g_cc_1}{\gamma}, \tag{38}$$

where

$$G_3 = \frac{-(h_1 - h_2)}{2}\frac{dp}{dx} + \frac{g_c}{(h_1 - h_2 - 2k_n)S_c\gamma}\Big((Ba_2 - Ab_9) - k_n\sqrt{S_c\gamma}(Aa_3 + Ba_4)\Big)$$

$$- \frac{g_cc_1(h_1 - h_2)}{2\gamma},$$

$$G_4 = -1 + \frac{a_{22}}{2(h_1 - h_2 - 2k_n)}\frac{dp}{dx} + \frac{g_c}{S_c\gamma(h_1 - h_2 - 2k_n)}\Big((h_2 + k_n)(k_n\sqrt{S_c\gamma}b_{16} - b_{18})$$

$$+ (h_1 - k_n)(k_n\sqrt{S_c\gamma}b_{17} + b_{19})\Big) + \frac{g_cc_1a_{22}}{2\gamma(h_1 - h_2 - 2k_n)},$$

$$b_{11} = (h_1 - h_2)^4,\quad b_{12} = (h_1 - h_2)^3,\quad b_{13} = (h_1 - h_2)^2, b_{14} = h_1h_2(h_1 - h_2),$$

$b_{15} = h_1^2 + h_2^2 - 4h_1h_2$, $a_{11} = -b_{11} + 8k_n b_{12} - 12k_n^2 b_{13}$, and
$a_{22} = b_{14} + k_n b_{15} - 2k_n^2 b_2$. (39)

5. Results and Discussion

We have presented a theoretical approach to study the combined effect of variable viscosity and chemical reaction of peristaltic flow. To analyze our results quantitatively, the integral in (36) is computed numerically for some values of physical parameters and the behaviour of the pressure gradient, pressure rise, the axial velocity, and concentration field for different values of Schmidt number S_c, Chemical reaction γ, phase difference ϕ, Knudsen number k_n and local mass Grashof number g_c is studied graphically.

5.1 Pumping characteristics

Fig.(2) shoes the effects of the slip parameter k_n on the variation of the pressure gradient $\frac{dp}{dx}$ versus x at a=0.7, b=0.8, d=1.5, S_c=0.5, $\gamma = 0.5$, $\phi = \frac{\pi}{4}$, $\alpha = 0.1$, m=-1, $g_c = 1$, $c_1 = 1$, $\theta = 1$ and ($k_n = 0, 0.001, 0.002$). It is shown that the pressure gradient decreases with increasing the slip parameter k_n. Moreover, it can be observed that in the wider part of the channel $x \in [0, 0.25]$ and $x \in [0.6, 1]$ the pressure gradient is relatively small, that is, the flow can easily pass without imposition of a large pressure gradient. On the other hand, in a narrow part of the channel $x \in [0.25, 0.6]$ a greater pressure gradient is required to maintain the flow to pass it.

In Fig.(3) the pressure gradient $\frac{dp}{dx}$ is graphed versus x at a=0.7, b=0.8, d=1.5, k_n=0.001, $\gamma = 0.5$, $\phi = \frac{\pi}{4}$, $\alpha = 0.1$, m=-1, $g_c = 1$, $c_1 = 1$, $\theta = 1$ and $S_c = (0.5, 0.6, 0.7)$. It can be noticed that the pressure gradient decreases with increase of Schmidt number S_c.

The effect of chemical reaction parameter γ on the pressure gradient is shown in Fig.(4) at a=0.7, b=0.8, d=1.5, k_n=0.001, $S_c = 0.5$, $\phi = \frac{\pi}{4}$, $\alpha = 0.1$, $m = -1$, $g_c = 1$, $c_1 = 1$, $\theta = 1$ and $\gamma = (0.5, 1, 1.5)$. It is clear that the pressure gradient decreases with increasing chemical reaction parameter γ .

Fig.(5) is made to see the variation of the phase difference ϕ on the pressure gradient $\frac{dp}{dx}$ at $a = 0.7, b = 0.8, d = 1.5, S_c = 0.5, \alpha = 0.1, k = 0.001, m = -1$, $g_c = 1$, $c_1 = 1, \theta = 1$ and $\phi = (0, \frac{\pi}{4}, \frac{\pi}{2})$. It is found that the pressure gradient $\frac{dp}{dx}$ decreases with increasing ϕ in both wider and narrow parts of the channel. Moreover, the narrow region in the channel is shifting to the left with an increase in ϕ.

Fig.(6) represents the variation of the pressure gradient $\frac{dp}{dx}$ versus x at a=0.7, b=0.8, d=1.5, k_n=0.001, $S_c = 0.5$, $\phi = \frac{\pi}{4}$, $\alpha = 0.1$, $m = -1$, $\gamma = 0.5$, $c_1 = 1$, $\theta = 1$ and $g_c = (1, 0.8, 0.6)$. The figure reveals that the pressure gradient increases with the increase of Local mass Grashof number g_c.

The variation of the pressure rise Δp versus flow rate θ at is displayed in Fig.(7) at $a = 0.5$, $b = 0.7$, $d = 1.5$, $S_c = 0.5$, $\gamma = 0.1$, $\alpha = 0.5$, $k = 0.001$, m=2, $g_c = 1$, $c_1 = 1$ and $\phi = (0, \frac{\pi}{8}, \frac{\pi}{6})$. As shown, the pressure rise decreases as the phase difference ϕ increases.

Fig.(8) depicts the variation of pressure rise with flow rate at a=0.5, b=0.7, $d = 1.5, S_c = 0.5, \gamma = 0.1, \phi = \frac{\pi}{2}, \alpha = 0.5, m = 2, g_c = 1, c_1 = 1$ and $k_n = (0.001, 0.002,$ 0.003). It can be seen that the pressure rise decreases as the slip parameter increases.

In Fig.(9), the dimensionless pressure rise Δp is graved versus flow rate θ at a=0.5, b=0.7, d=1.5, $S_c = 0.5$, $\phi = \frac{\pi}{6}$, $\alpha = 0.5$, $k_n = 0.05$, $m = -1$, $g_c = 1$ and $\gamma = (0.1,\ 0.11,$ 0.12). We observe that an increase of the chemical reaction parameter γ causes a decrease in the magnitude of the pressure rise Δp.

The effect of Schmidt number S_c on the pressure rise is shown in Fig.(10) at a=0.5, b=0.7, d=1.5, $\gamma = 0.1$, $\phi = \frac{\pi}{2}$, $\alpha = 0.5$, $k_n = 0.001$, $m = 2$, $g_c = 1$, $c_1 = 1$ and $S_c = (0.5, 0.6, 0.7)$. We notice that the pressure rise decreases as the Schmidt number S_c increases.

Fig.(11) shows the effects of the Local mass Grashof number g_c on the pressure rise Δp at certain values of physical parameters of the problem.

It is observed that the pressure rise increases by increasing Local mass Grashof number.

5.2 Velocity distribution

Figs.(12-16) are prepared to see the effects of various parameters on the axial velocity. From these figures, we recall that the axial velocity increases with the increase in phase difference ϕ, slip parameter k_n, Grashof number g_c while it decreases with the increase in chemical reaction parameter γ and Schmidt number S_c.

5.3 Concentration distribution

The effects of Schmidt number S_c, chemical reaction parameter γ and phase difference ϕ on concentration profiles have been shown through figures (17-19), respectively. Figs.(17) displays the graph of the concentration distribution Φ versus y at $x = 0,\ m = 2,\ c_1 = 1,\ \gamma = 0.5,$ $a = 0.7,\ b = 0.8,\ d = 1.5,\ \theta = 1,\ \phi = \frac{\pi}{3}$ and $S_c = (0.7, 0.6, 0.5)$. It is seen that an increase in Schmidt number S_c decreases the concentration distribution Φ. A similar result is seen in Fig.(18) when increasing the chemical reaction parameter γ.

Finally, Fig.(19) represents the variation of the concentration distribution Φ versus y at $x = 0,\ m = 2,\ c_1 = 1,\ \gamma = 0.5,\ a = 0.7,$ $b = 0.8,\ d = 1.5,\ \theta = 1,\ S_c = 0.5$ and $\phi = (0, \frac{\pi}{6}, \frac{\pi}{3})$. It is clear that the concentration distribution Φ increases with increasing phase difference ϕ.

6.Concluding Remarks

This studied the effects of variable viscosity and chemical reaction on peristaltic slip flow in an asymmetric vertical channel. Using long wavelength approximation, analytic solution for the axial velocity, the concentration field and the pressure gradient are obtained. Furthermore, numerical computations have been carried out for the pressure rise. The main results can be summarized as follows:

• The pressure gradient decreases with an increase of the slip parameter , Schmidt number S_c, chemical reaction parameter γ, phase difference ϕ,

• The pressure gradient increases with the increase of Grashof number g_c.

• The pressure rise decreases with the increasing phase difference ϕ , the slip parameter, the Schmidt number S_c,

• The magnitude of the pressure rise Δp decreases with an increase in the chemical reaction parameter γ.

• The pressure rise increases by increasing Local mass Grashof number.

• The axial velocity increases with the increase in phase difference ϕ, slip parameter k_n, Grashof number g_c while it decreases with the increase in chemical reaction parameter γ and Schmidt number S_c.

• The concentration distribution Φ increases with the increase of phase difference ϕ while it decreases with the increasing Schmidt number S_c and the chemical reaction parameter γ.

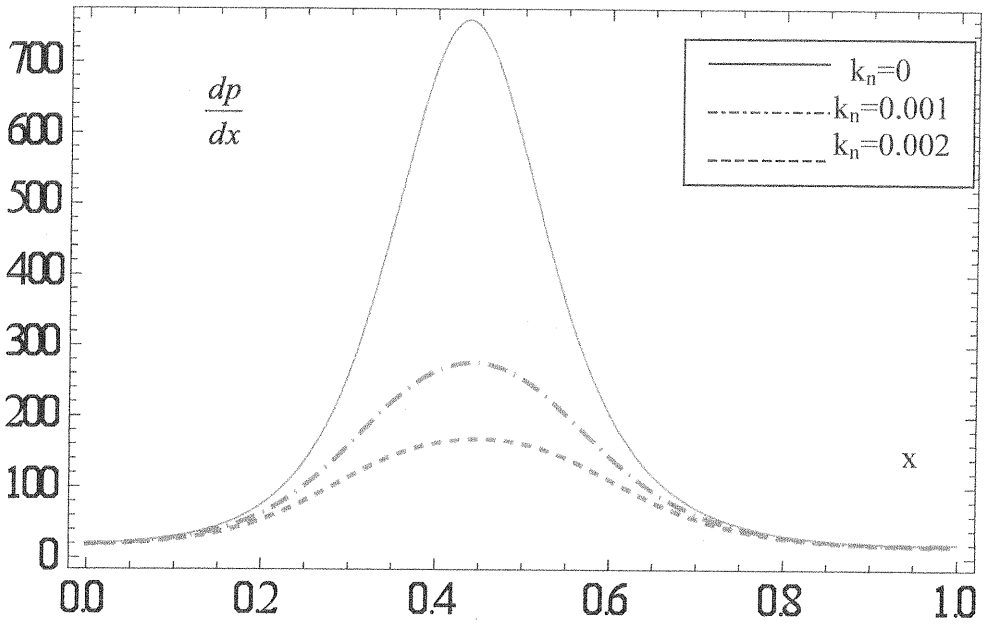

Fig.(2) Pressure gradient at a=0.7, b=0.8, d=1.5, S_c=0.5, γ=0.5, ϕ =π/4, α =0.1, m=-1, g_c=1, c_1=1, θ =1 .

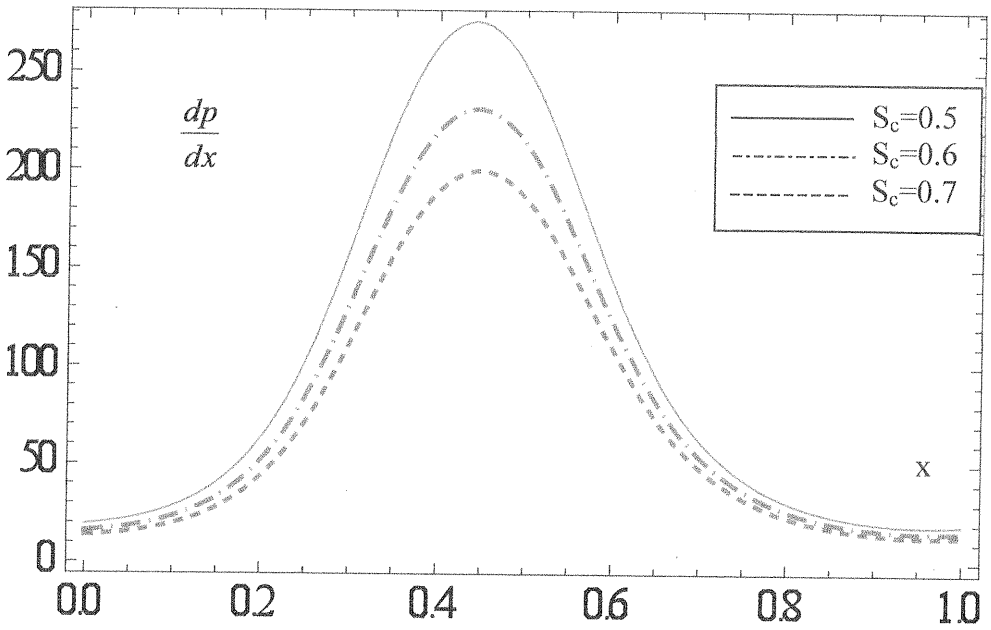

Fig.(3) Pressure gradient at a=0.7, b=0.8, d=1.5, k_n =0.001, γ=0.5, ϕ =π/4, α =0.1, m=-1, g_c=1, c_1=1, θ =1 .

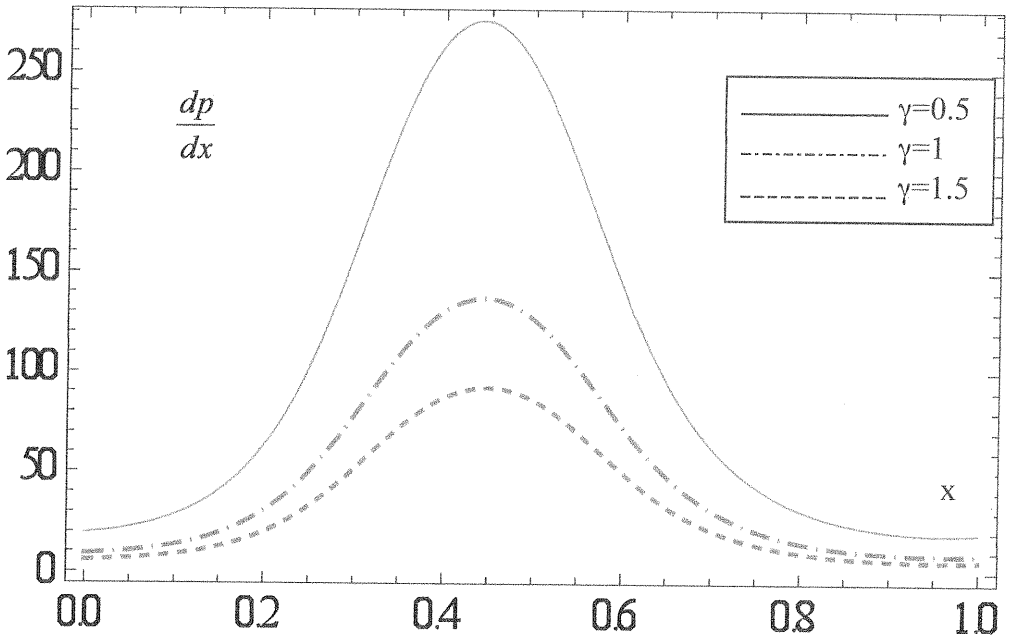

Fig.(4) Pressure gradient at a=0.7, b=0.8, d=1.5, S_c=0.5, k_n =0.001, ϕ =π/4, α =0.1, m=-1, g_c=1, c_1=1, θ =1 .

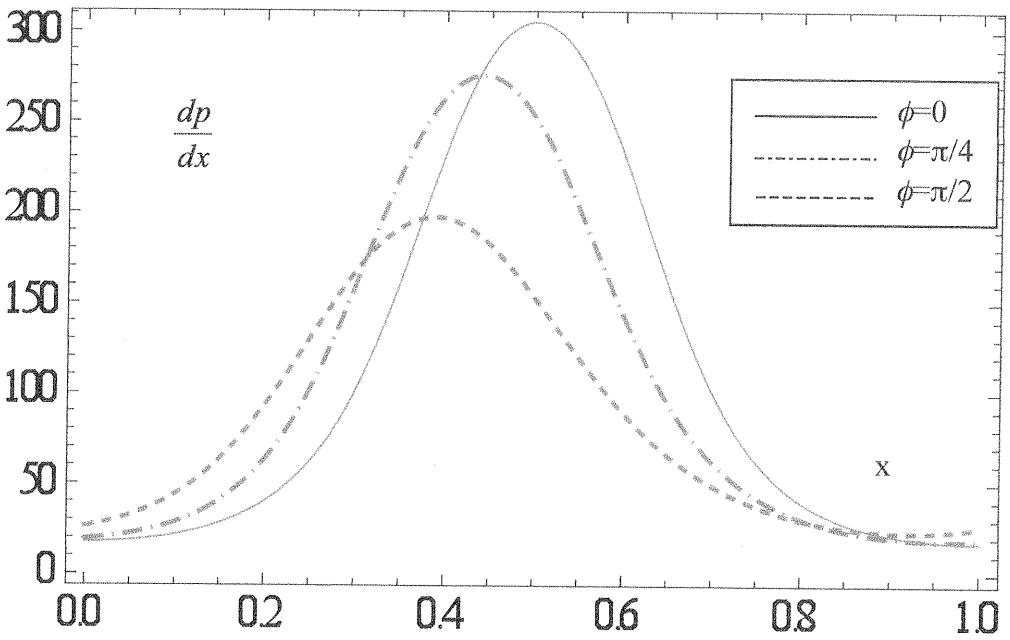

Fig.(5) Pressure gradient at a=0.7, b=0.8, d=1.5, S_c=0.5, k_n =0.001, γ=0.5, α =0.1, m=-1, g_c=1, c_1=1, θ =1 .

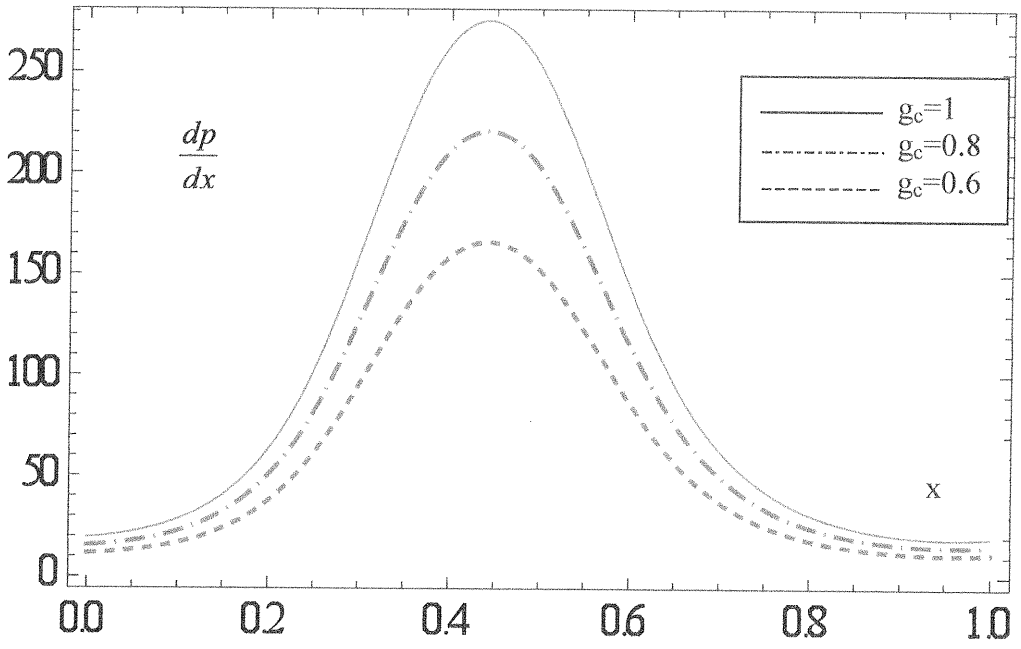

Fig.(6) Pressure gradient at a=0.7, b=0.8, d=1.5, S_c=0.5, k_n =0.001, ϕ =π/4, α =0.1, m=-1, γ=0.5, c_1=1, θ =1 .

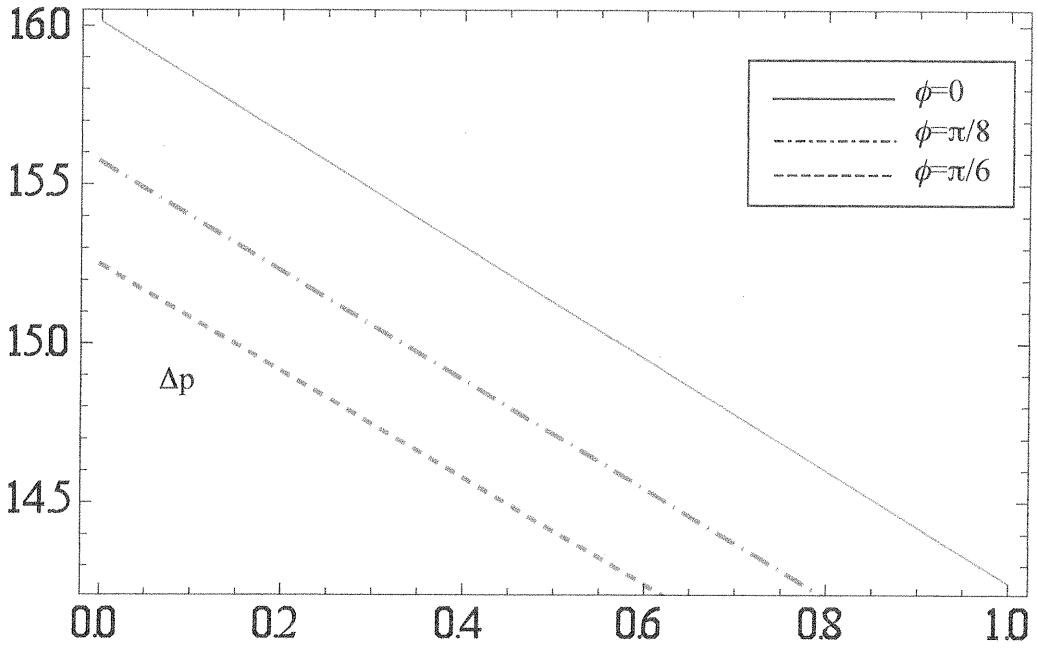

Fig.(7) Pressure rise versus flow rate at a=0.5, b=0.7, d=1.5, S_c=0.5, k_n =0.001, γ=0.1, α =0.5, m=2, g_c=1, c_1=1 .

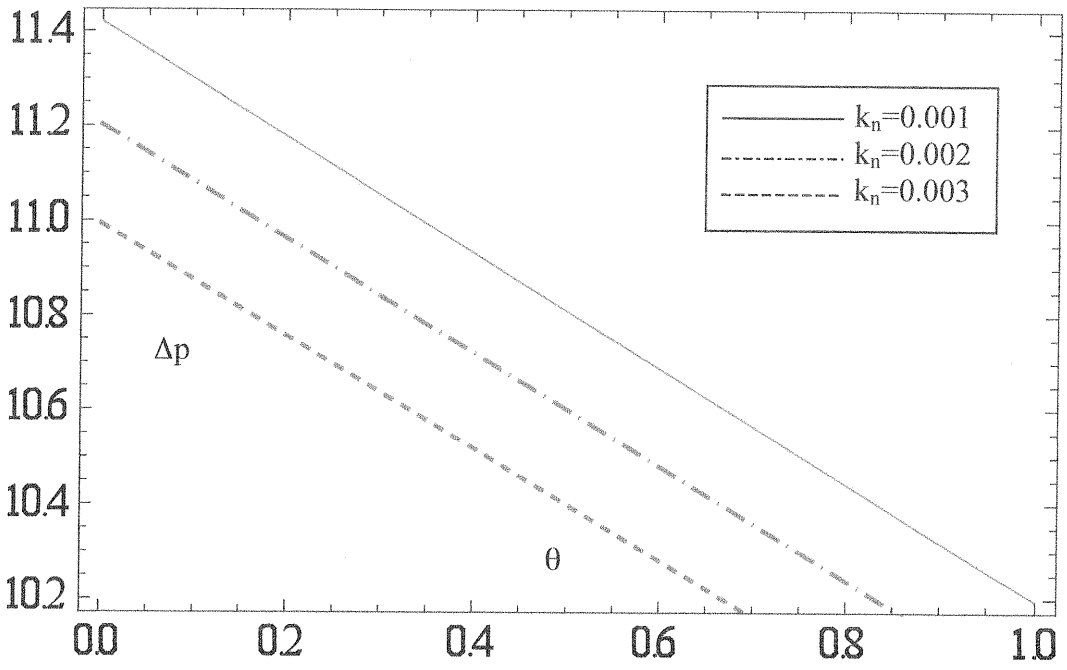

Fig.(8) Pressure rise versus flow rate at a=0.5, b=0.7, d=1.5, S_c=0.5, $\phi = \pi/2$, γ=0.1, α=0.5, m=2, g_c=1, c_1=1 .

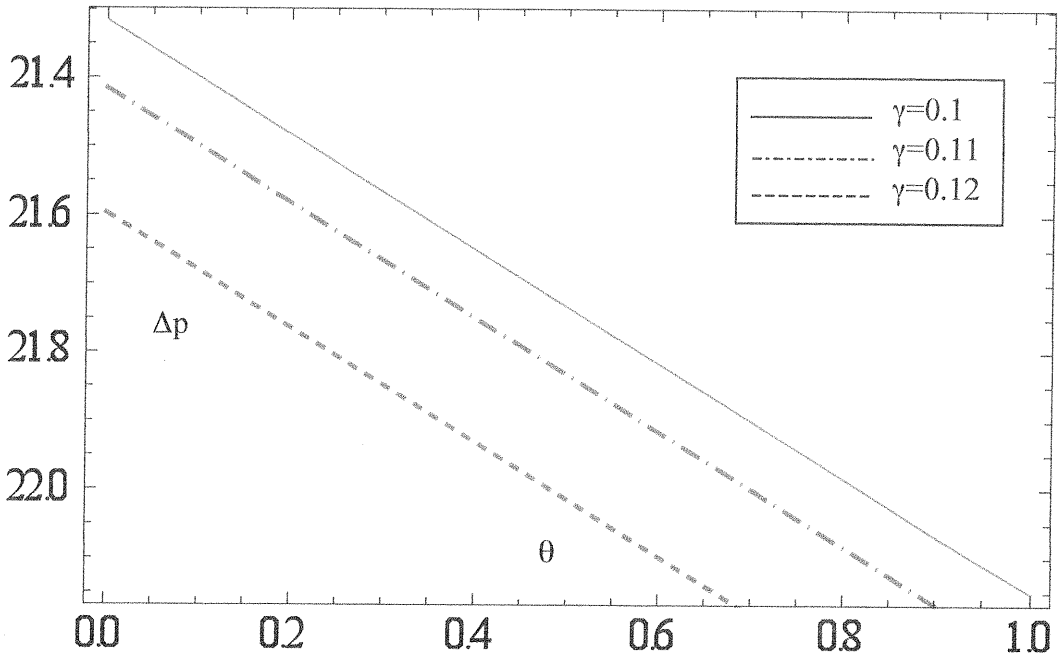

Fig.(9) Pressure rise versus flow rate at a=0.5, b=0.7, d=1.5, S_c=0.5, $\phi = \pi/6$, k_n =0.05, α=0.5, m=-1, g_c=1, c_l=1 .

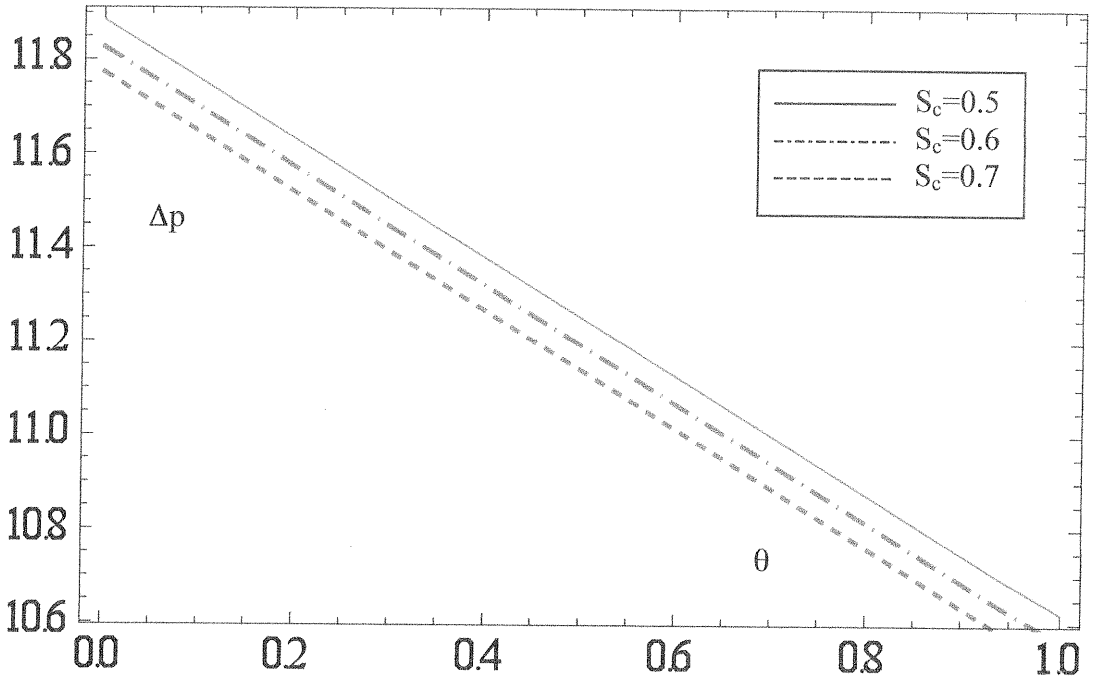

Fig.(10) Pressure rise versus flow rate at a=0.5, b=0.7, d=1.5, γ=0.1, $\phi = \pi/2$, k_n=0.001, α=0.5, m=2, g_c=1, c_1=1 .

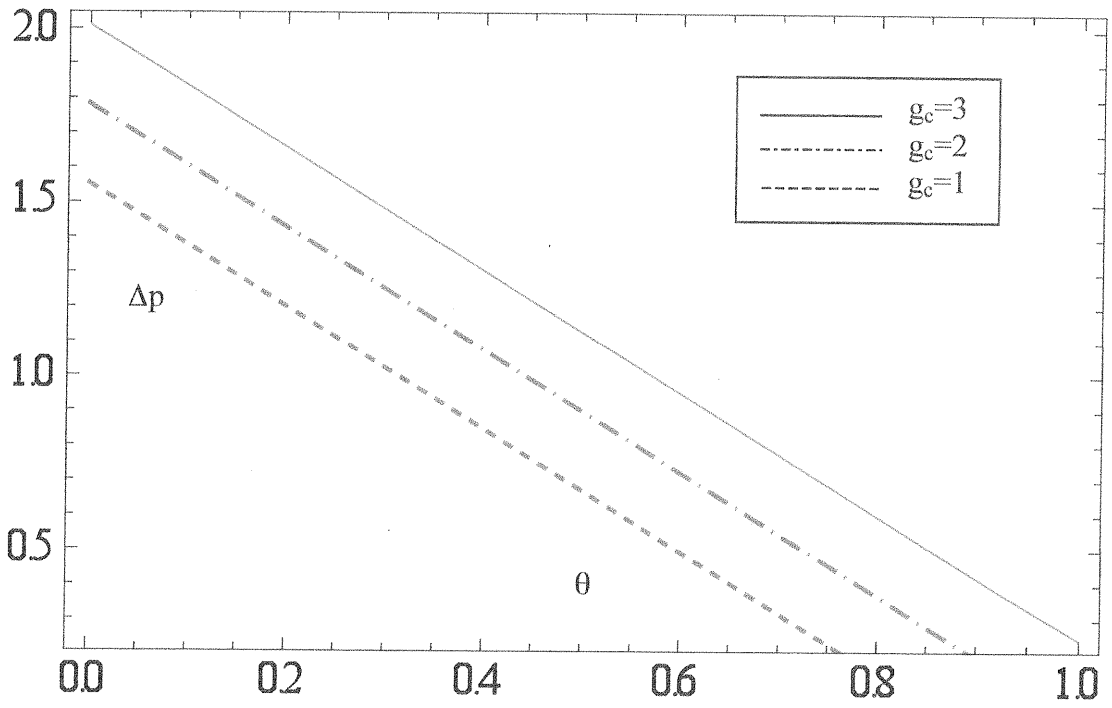

Fig.(11) Pressure rise versus flow rate at a=0.5, b=0.7, d=1.5, γ=0.1, ϕ=0, k_n=0.001, α=0.5, m=1, S_c =0.1, c_1=1 ..

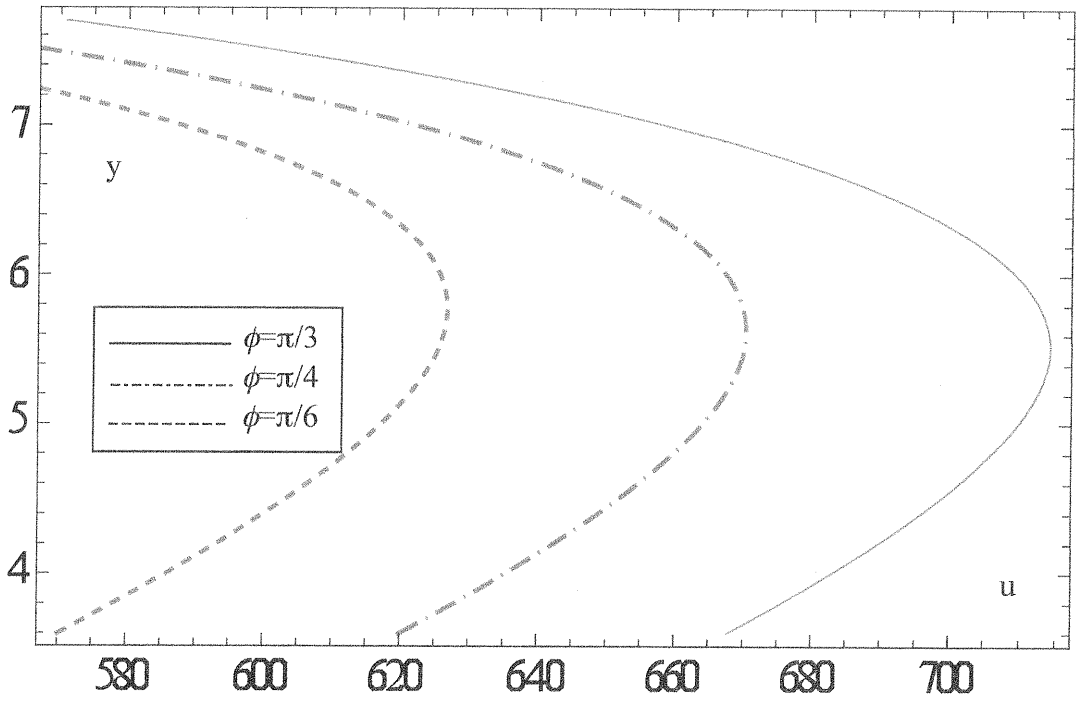

Fig.(12) Velocity distribution at x=0.2, a=0.5, b=0.7, d=2, S_c=0.5, k_n =0.05, γ=0.5, α=0.1, m=2, g_c=2, c_1=1, θ =1 ..

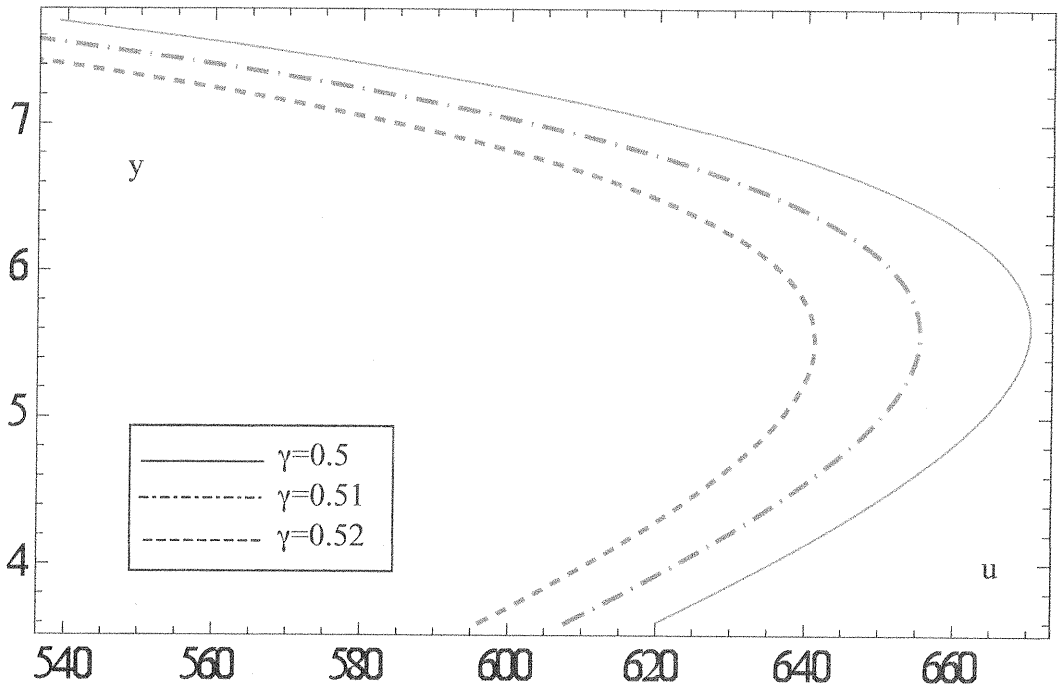

Fig.(13) Velocity distribution at x=0.2, a=0.5, b=0.7, d=2, S_c=0.5, k_n =0.05, ϕ =π/4, α=0.1, m=2, g_c=2, c_1=1, θ =1.

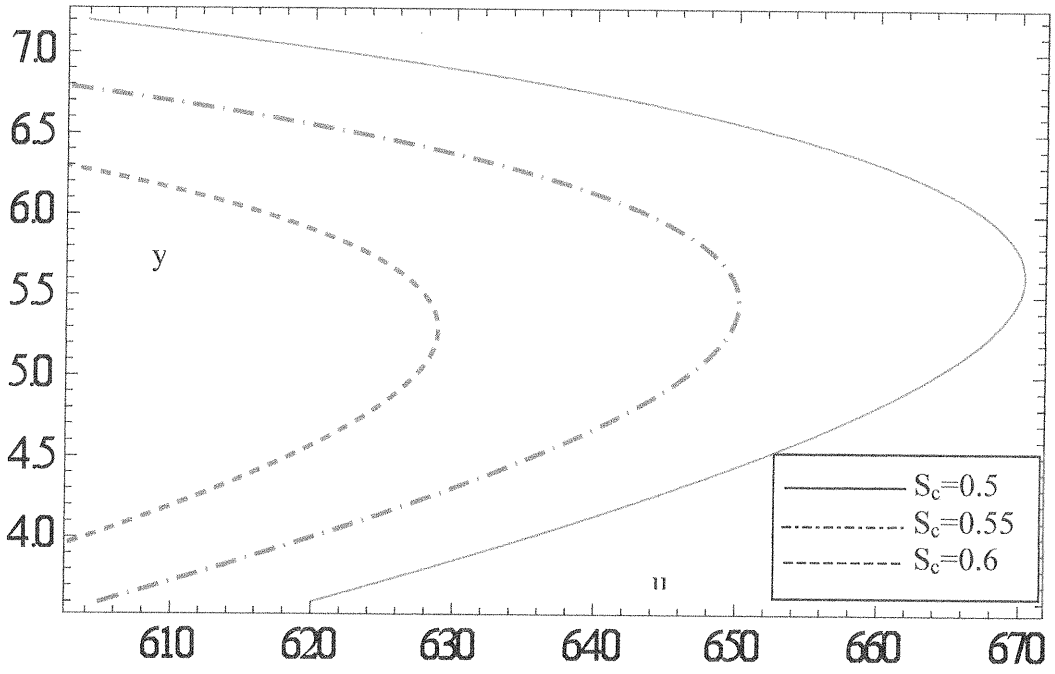

Fig.(14) Velocity distribution at x=0.2, a=0.5, b=0.7, d=2, γ =0.5, k_n =0.05, ϕ =π/4, α=0.1, m=2, g_c=2, c_1=1, θ =1 .

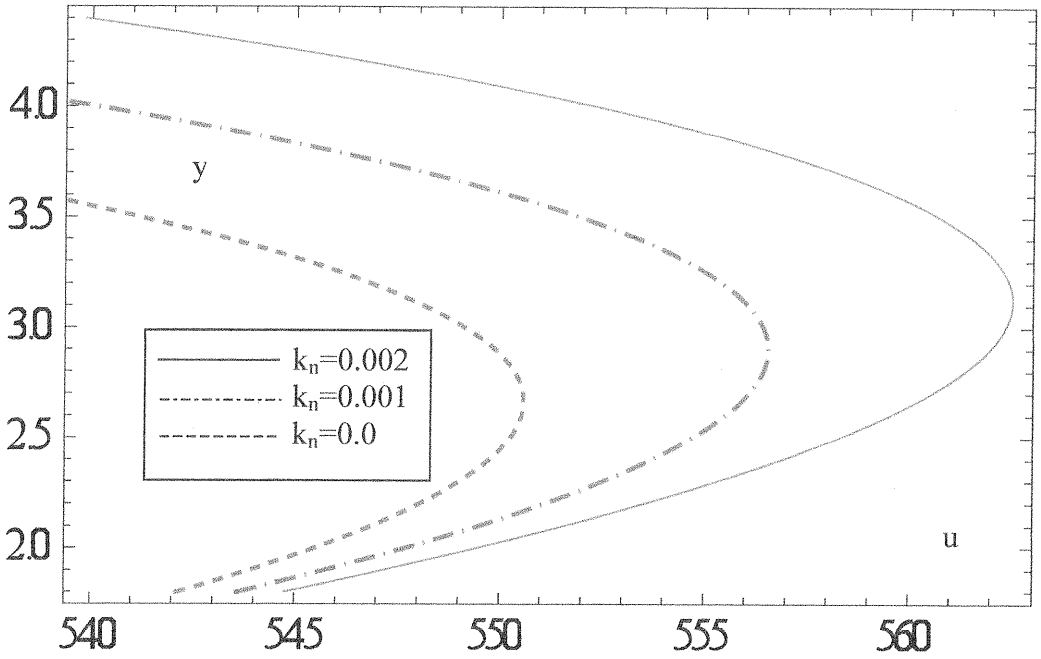

Fig.(15) Velocity distribution at x=0.2, a=0.5, b=0.7, d=2, γ =0.5, S_c =0.5, ϕ =π/4, α=0.1, m=2, g_c=2, c_1=1, θ =1 .

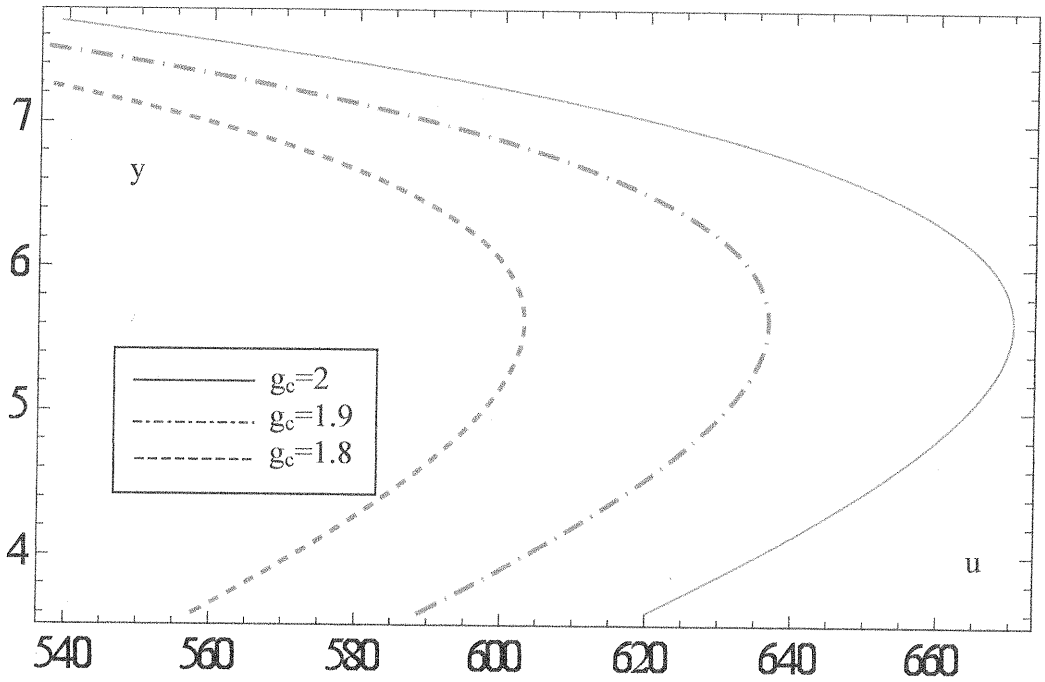

Fig.(16) Velocity distribution at x=0.2, a=0.5, b=0.7, d=2, γ =0.5, S_c =0.5, ϕ =π/4, α=0.1, m=2, k_n =0.05, c_1=1, θ =1.

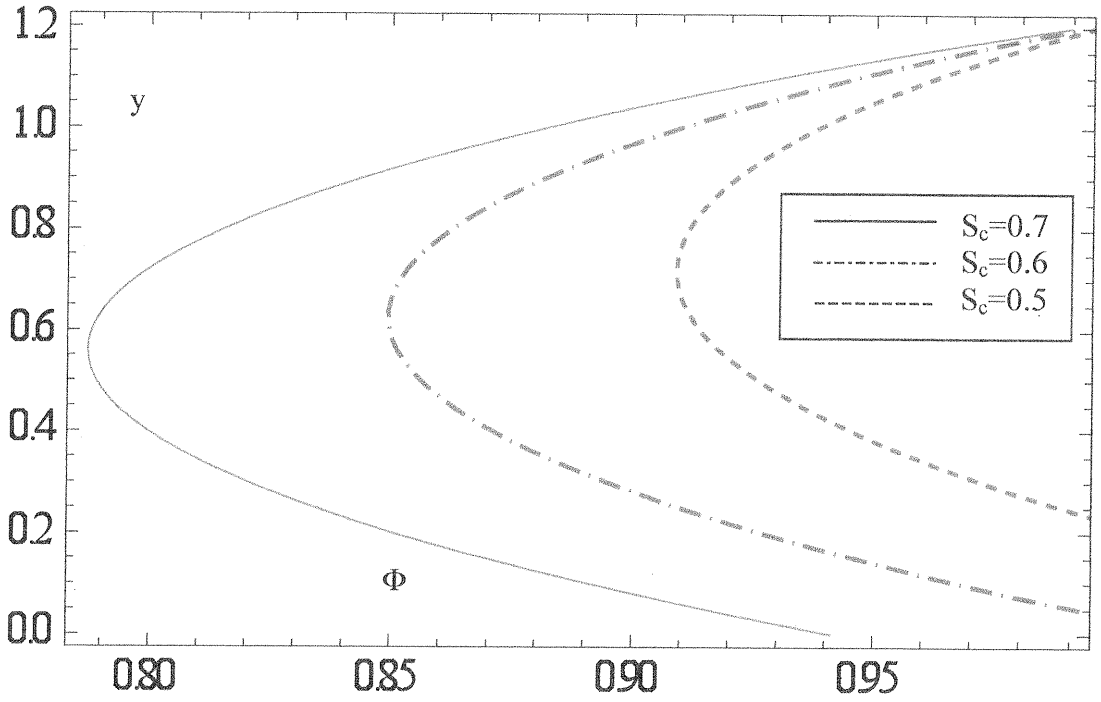

Fig.(17) Concentration distribution at x=0, a=0.7, b=0.8, d=1.5, γ =0.5, ϕ=π/3, m=2, c_1=1, θ =1 .

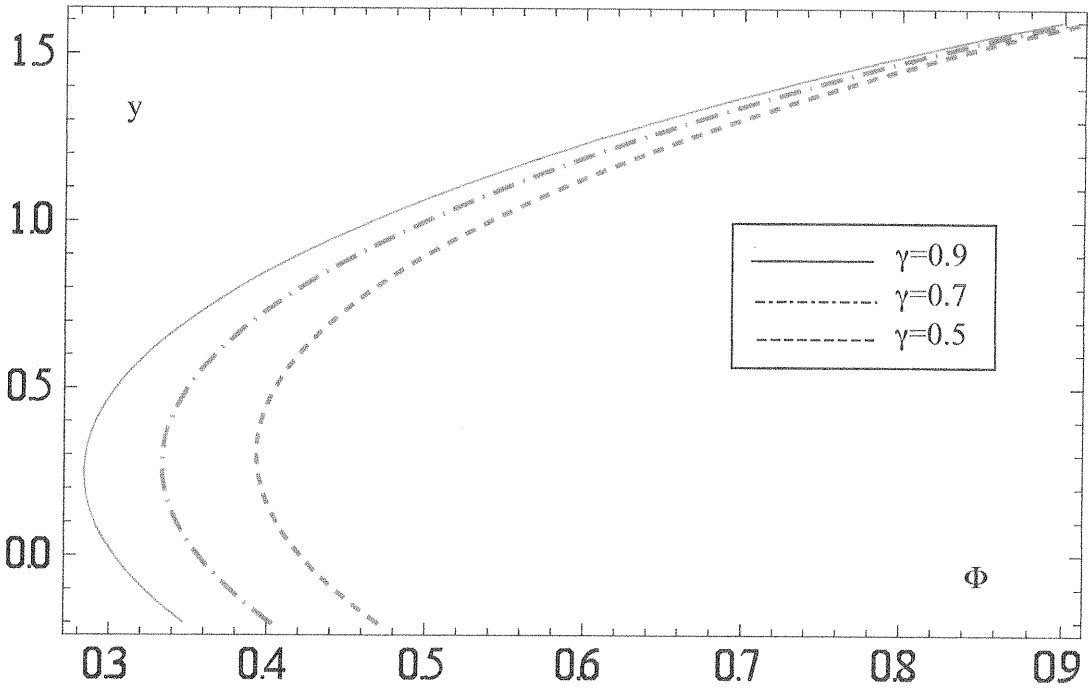

Fig.(18) Concentration distribution at x=0, a=0.7, b=0.8, d=1.5, S_c =0.5, ϕ=π/3, m=2, c_1=1, θ =1.

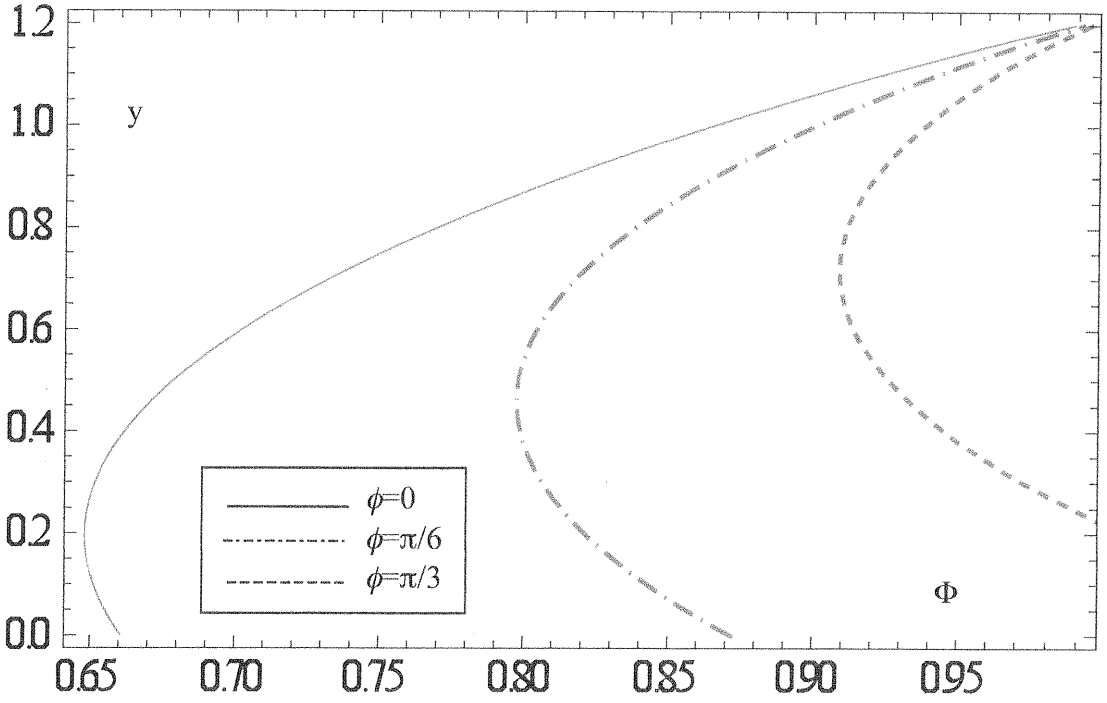

Fig.(19) Concentration distribution at x=0, a=0.7, b=0.8, d=1.5, S_c =0.5, γ =0.5, m=2, c_1=1, θ =1.

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BASES OF CREATIVE PARTICLES OF HIGGS THEORY (CPH THEORY)

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Abstract

One way to explain the Zero Point Energy (ZPE) is by means of the uncertainty principle of quantum physics, In CPH Theory the ZPE explained by using a novel description of the gravitons. This is based on the behavior of photons in a gravitational field, leading to a new definition of the graviton. In effect, gravitons behave as if they have charge and magnetic effects. From this, it can be shown that a photon is made of color charges and magnetic

According to the results of this looking on gravitons we can definitely say that the best way for unifying the interactions is generalizing color charge from the structure of photon to nuclear. These color charges and magnetic color form the energy. Energy converts to matter and anti-matter such as charged particles. Charged particles use gravitons and generate electromagnetic field. This way of looking at the problem show how two opposite charged particles repel each other in far distance and absorb each other at a very small distance.

Keywords: Zero point energy, Dirac equation, Hawking radiation, graviton, pair production, color-charge, magnetism color, photon, virtual photon, interactions, vector bosons, strong interaction, electroweak, broken symmetric, electromagnetic, spin, negative and positive photon, Higgs.

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1 Introduction;

Scientists describe the universe in terms of two basic partial theories - the general relativity and quantum mechanics... The general theory of relativity describes the force of gravity and the large-scale structure of the universe. Quantum mechanics, on the other hands, deals with phenomena on extremely small scales. These two theories are known to be inconsistent with each other - they cannot both be correct. There are many ways to do combine these theories and many theories such as Loop Quantum Theory and String Theory had propounded.

But Theory of CPH (Creative Particles of Higgs) takes a new way. CPH Theory has reconsidered 4 theories (Classical Mechanics, Quantum Mechanics, Relativity and Higgs). In fact CPH Theory is a new looking and developing of **Quantum Chromodynamic**. So, CPH Theory is a **Sub Quantum Chromodynamic theory**. In fact we must do change our understanding of graviton.

We know there is a unit informer in universe that is photon, and all of our information of universe transfer by photon. Until we do not know everything about photon and its structure, our information's about universe is questionable. Notice that many physicists, such as Faraday and Planck noted the great similarities between electric fields and gravity. If a unified field theory can be found, someone must resolve whether or not it is based on particles and gravity fields or electromagnetic fields. But CPH theory is some in between these two concepts.

CPH Theory started of relationship between force and energy. Photon appears to have no further internal substructure. But many phenomenon as Compton's effect, pair production, red-shift and blue-shift... lead CPH Theory show photon has a structure.

Theory of CPH have proclaimed by a simply definition of CPH and a principle that calls CPH Principle. In fact CPH theory is an empiric and sensibility theory. And it does different CPH Theory with other theories. Shortly, CPH theory proclaims the following conceptions;

1- When we will be able to explain quantum level phenomenon, that we do thinking on sub quantum quantities.

2- To explaining relationship between fermions and bosons, we must do change our mind of gravity and graviton. In fact gravitons behave like charge or magnet force in sub quantum levels.

3- We never can do combine Quantum mechanics with General Relativity without attention to Higgs theory. In fact there is an especial relationship between force and energy like mass and energy in relativity. This shows we reconsider the second Newton's law. It

shows a unified theory comes up of reconsideration the quantum mechanics, relativity, Higgs theory and classical mechanics.

In CPH Theory, the ZPE (Zero Point Energy) explained by using a novel description of the graviton. This is based on the behavior of photons in a gravitational field, leading to a new definition of the graviton. In effect, gravitons behave as if they have charge and magnetic effects.

These are referred to as negative color charge, positive color charge and magnetic color. From this, it can be shown that a photon is made of color charges and magnetic color. This definition of the structure of a photon leads to an explanation of how the vacuum produces Zero Point Energy (ZPE).

Also, these color charges and magnetic color form the electromagnetic energy. Electromagnetic energy converts to matter and anti-matter such as charged particles. Charged particles use gravitons and generate electromagnetic field. In fact, a charged particle is a generator for producing virtual photons, both negative and positive photons. This view shows how two oppositely charged particles repel each other in greater distance and absorb each other at a very small distance. To conclude, it shows how quarks produce vector bosons. In general, it appears that all known interactions between objects can be described through negative and positive color charges.

2 The Photon in a gravitational field

Looking at the behavior of a photon in a gravitational field can help resolve vacuum energy. The fields around a "ray of light" are electromagnetic waves, not static fields. The electromagnetic field generated by a photon is much stronger than the associated gravitational field. Suppose a photon falls in a gravitational field, its energy (mass) increases. According to;

$$W = \Delta mc^2$$

The force of gravity performs work on the photon, so the mass (energy) of the photon increases.

However, the energy of a photon depends on its electric and magnetic fields. Therefore, one part of the work done by gravity converts to electrical energy and the other part converts to magnetic energy. How can the Higgs boson show how particles acquire mass? Moreover, according to the Higgs boson, what happens in during the blue shift?

3 Color-charges and color-magnetism

The change of frequency of a photon in a gravitational field has been demonstrated by the Pound-Rebka experiment. When a photon falls in a gravitational field, it acquires energy equal to;

$$E = \Delta mc^2$$

Which separates into three parts; one part behaves like a positive electric field and another part behaves like a negative electric field. These neutralize each other in the structure of the photon (a photon itself is neutral) and the third part behaves like a magnetic field.

In quantum mechanical theory, every field is quantized. In addition, force is described as energy per distance shown by:

$$F = -\frac{dU}{dx} \qquad (1)$$

If we consider this equation from the aspect of quantum mechanics, a graviton enters into the structure of a photon, carrying gravitational force. As a result, a graviton disappears and the energy of the photon increases.

Similarly, Red Shift has the opposite effect. As a photon escapes from a gravitational field, its frequency shifts to red and its energy converts to gravitons. How can we describe this interaction between photons and gravitons on a sub-quantum scale such as in the structure of a photon?

Another consideration is virtual particles, implied by the uncertainty principle in the form:

$$\Delta E \Delta t \geq \hbar \,,\ \hbar = \frac{h}{2\pi} \qquad (2)$$

In the vacuum, one or more particles with energy ΔE above the vacuum may be created for a short time Δt. So, any analysis of the ZPE should be able to explain this particle production and even Hawking radiation in a strong gravitational field such as that of a black hole. To do this, the best way is to use the Dirac equation, which originally demonstrated the possibility of a particle pair, that is, a particle and anti-particle. The relationship between energy and momentum for a massless particle is given by;

$$E = |P| c \qquad (3)$$

Now it is possible to change the definition of the rest mass of a particle. As we know, some particles such as photons are never seen at rest in any reference frame. According to relativity however, they do have mass that derives from their energy. For example, a photon has a mass given by:

$$E=mc^2=h\nu \quad \Rightarrow \quad m=\frac{h\nu}{c^2} \qquad (4)$$

So, there are two kinds of particles in physics;

- Some particles like the photon move only with the speed of light c, in all inertial reference frames. Let's call this kind the NR particles or Never at Rest condition particles

- Other particles like the electron always move with speed v<c in all inertial reference frames; they have a rest mass, and could not call NR particles.

According the above definition, photons and gravitons are NR particles, while electrons and protons are not NR particles.

Suppose a photon with NR mass m and energy $E=h\nu$ falls toward the earth relative to an inertial reference frame on the surface of earth. Its frequency increases from ν to ν', and a large number of gravitons enter into the structure of the photon such that $\Delta\nu = \nu' - \nu$. The problem is; how many gravitons enter into a photon to provide the least possible photon energy change (minimum$\Delta\nu$)?

Now, according to this argument, in order to calculate the number of gravitons involved in $\Delta\nu$ and to explain their properties, suppose a photon with frequency ν is formed of n_1 elements, and with a frequency ν' it contains n_2 elements. These elements are not the same, because they exhibit different properties. Let's propose a 1×4 matrix

$$[A \quad B \quad C \quad D]$$

Now we need to calculate A, B, C and D so that they satisfy the properties of a photon. When gravity works on a photon, gravitons enter into the photon and the intensity of its electric field increases.

The photon has no electrical effect; therefore A and B must carry electric field around the photon with opposite effect. So, according to the relative intensity of electric and magnetic fields E=cB, we can write;

$$A=cH^{+}. \quad B=cH^{-}. \qquad c \text{ is the speed of light}$$

Here H^{+} is positive color-charge and H^{-} is negative color-charge. In addition, in the above relation c is a mathematical constant that relates E and B in electromagnetism. So, let's show $c=\kappa$. Then the above relation becomes:

$$A=\kappa H^{+}. \quad B=\kappa H^{-}. \qquad \kappa \text{ is a mathematical constant}$$

When a large count of H^{+} enters into a photon, the intensity of its positive electric field increases. According to the Maxwell equations, the intensity of its magnetic field increases as well.

Also, element C must carry a magnetic effect around the positive color-charges and the same applies to the D element for the negative color-charges. Therefore, C and D are the same but with opposite direction. So, according to the relationship between the intensity of electric and magnetic fields, we can write;

$$C=H^{m}. \quad D=-H^{m}$$

Then the matrix [A B C D] takes the following form here named the CPH matrix;

$$[CPH] = \begin{bmatrix} \lambda H^{+} & \lambda H^{-} & H^{m} & H^{m} \end{bmatrix} \qquad (5)$$

According to the above expression, we are now able to define the least magnitude of a photon. A photon of minute energy contains some positive color-charges H^{+}, negative color-charges H^{-}, right rotation color-magnetism H^{m} and left rotation color-magnetism $-H^{m}$ as shown in the CPH matrix (relation 5). This very small energy can be express as the following;

$$\text{Minute electromagnetic energy} = (2\lambda + 2)E_{CPH} \qquad (6)$$

Note; the energy of a CPH (E_{CPH}) is defined later in relation (8).

The argument is now in a position to offer some supportable propositions about the photon and a new definition of the graviton.

4 Gravitons

Many physicists believe the graviton does not exist, at least not in the simplistic manner in which it usually envisioned. Superficially speaking, quantum gravity using the gauge interaction of a spin-2 field (graviton) fails to work the way that the photon and other gauge bosons do.

Maxwell's equations always admit a spin-1, linear wave, but Einstein's equations rarely admit a spin-2, linear wave, and when they do it is not exact.

However, in the present article the photon is made of gravitons. To resolve this, we need to continue with the definition of CPH and the Principle of CPH and then return to properties of a graviton.

5 Definition of a CPH

What is a CPH? It is the Creative Particle of Higgs, or, CPH is an existence unit of nature. In other words, everything is made of CPH. Therefore, a CPH is appropriately

referred to as the unit of nature, although this not meant to be a "particle" as this concept has been traditionally referred to in physics.

A CPH is a NR particle, with a constant NR mass m_{CPH}, which moves with a constant magnitude speed of $V_{CPH} > c$ in any inertial reference frame, where c is the speed of light. According to the mass-energy relation, the NR mass of a CPH is defined relative to a photon's NR mass by;

$$m_{CPH} < m = \frac{h\nu}{c^2} \quad \forall \ \nu \qquad (7)$$

And the relationship between energy and momentum for the NR mass CPH is given by;

$$E_{CPH} = |P_{CPH}| \cdot V_{CPH} = \text{constant} \qquad (8)$$

Relation (8) shows that the energy of every CPH is constant in any interaction between two (or more) CPH or other particles. So, given $|V_{CPH}|$ cannot alter, they must take on spin to conserve the total energy.

In other words, in any inertial reference frame and Cartesian components;

$$|V_{CPH}(x)| + |V_{CPH}(y)| + |V_{CPH}(z)| = |V_{CPH}| \qquad (9)$$

CPH has no spin

$$|V_{CPH}(x)| + |V_{CPH}(y)| + |V_{CPH}(z)| < |V_{CPH}| \qquad (10)$$

CPH has spin

When a CPH has spin, it is called a graviton

Simply, a lone graviton without spin is a CPH. When;

$$\left|V_{CPH}(x)\right|+\left|V_{CPH}(y)\right|+\left|V_{CPH}(z)\right|\geq c \quad (11)$$

There is no difference between bosons and fermions. In this case, a CPH carries gravitational force and behaves like a fermion. Therefore, there are color-charges, only.

When;

$$\left|V_{CPH}(x)\right|+\left|V_{CPH}(y)\right|+\left|V_{CPH}(z)\right|\leq c$$

the magnetic effect appears.

For particles like electrons or quarks;

$$\left|V_{CPH}(x)\right|+\left|V_{CPH}(y)\right|+\left|V_{CPH}(z)\right|<c \quad (12)$$

Other bosons also occur. For example, reconsider pair production. Before pair production, there is a photon only. After pair production there is an electron, positron and a virtual photon (boson) that carries electromagnetic force. So, we can write:

$$\left|V_{CPH}(y)\right|+\left|V_{CPH}(z)\right|<c \quad (13)$$

Spontaneous Symmetry Breaking has occurred.

Accordingly, a CPH with spin is called a graviton, so space is full of CPH. Increasing density of CPH in space causes their separation to decrease until they feel and absorb each other.

Suppose two CPH are moving in the x-axis direction and absorb each other, such that their paths change without decreasing the magnitude of V_{CPH}. According to relation (8), we are able to construct an operator $R_x(\Delta\varphi)$, which rotates a CPH by an angle $\Delta\varphi$ about the x-axis (toward z-axis or y-axis) in position space. Also, we can construct $T_x(\Delta\varphi)$ which rotates the CPH by $\Delta\varphi$ about the x-axis in spin space. We would expect such an operator to take the form;

$$T_x(\Delta\varphi) = \exp(-\frac{is_x\Delta\varphi}{\hbar}) \qquad (14)$$

Thus, according to this expression, two interacting CPH rotate each other, but they cannot have same direction of spin. They spin in opposite directions. If positive color-charge has up spin, then negative color-charge must take on down spin.

6 Principle of the CPH theory

CPH is a unit of minuscule energy with a constant NR mass (m_{CPH}) that moves with a constant magnitude of speed such that $|V_{CPH}| > |c|$, in all inertial reference frames.

Any interaction between CPH and other existing particles represents a moment of inertia **I** where; the magnitude of V_{CPH} $(\text{or}|V_{CPH}|)$ is constant and never changes. Therefore,

$$\nabla|V_{CPH}| = 0 \text{ in all inertial reference frames and any space}$$

Based on the principal of CPH, a CPH has two types of energy generated by its movement within its inertial frame. One is translational and the other is spin. In physics, we represent energy summation (both kinetic and potential) by a Hamiltonian equation and energy difference by a LaGrangian. Therefore, in the case of CPH, we use a Hamiltonian to describe the summation of energy generated by translation and spin as follows:

$$E_{CPH} = T + S \qquad (15)$$

Where T is translational and S is spin energy of a CPH respectively. Since the speed and mass of CPH are constant, then $E_{CPH} = \text{constant}$. CPH produces energy and energy produces Matter and Anti-Matter. In fact, everything has been formed of CPH.

7 CPH and the cyclic group

As explained above, gravitons in interaction with each other convert to color-charges and color-magnetism. In addition, when a CPH has spin, it is calling a graviton. Therefore, we can define a cyclic group for electric field that is generated by gravitons. So, G<g> given by;

$$G\langle g\rangle = \{ nH^{+}, nH^{-} \mid n \in Z \} \qquad (16)$$

Suppose 2n color-charges (nH^{+} and nH^{-}) combine and move in space. There are two electric fields with opposite sign in that space. About each such field a magnetic field forms, produced by gravitons. According to the signs of these fields, the direction of this magnetism is different, so their elements are same. Therefore, there is a cyclic group given by:

$$G\langle g\rangle = \{ kH^{m} \mid k \in Z \} \qquad (17)$$

According to the above group and the CPH matrix (relation 5), we can explain zero point energy.

8 Zero Point Energy

Space is full of gravitons. Gravitons interact with each other and convert to color-charges Interaction between gravitons depends on their density $\rho(g)$ in a given volume. Energy production is given by:

$$E = \iiint_{V} \rho(g)\, dx\, dy\, dz \qquad (18)$$

According to the above expression, we are able to explain the mechanism of ZPE.Some gravitons with the same NR mass CPH m convert to color-charges, and two electric fields form. These fields neutralize each other. However, positive color-charges repel each other, and the same action applies to the negative color-charges.

Therefore, when the intensity of color-charges grows, about each field (negative and positive fields) a magnetic field forms. This magnetic field maintains the electric field. This mechanism is explainable by the Larmor radius (gyroradius or cyclotron radius) given by;

$$r_g = \frac{mv_\perp}{|q|B} \qquad (19)$$

Where r_g is the gyroradius, m is the mass of the charged particle, v□is the velocity component perpendicular to the direction of the magnetic field, q is the charge of the particle, and B is the constant magnetic field.

This defines the radius of circular motion of a charged particle in the presence of a uniform magnetic field. When; color-charges change in the structure of a photon, then magnetic-color changes too. Therefore the electric fields do not decay in the structure of a photon. In general, a photon has been formed of two parts;

1- A large number of negative color charges and magnetic color. Magnetic color maintains color charges in a tube-like distribution, so negative magnetic color forms an appropriate negative electric field. In addition, the same happens for positive electric field in the opposite sense. So it is now possible to demonstrate the least possible negative color charges with their magnetic color by ◁, so that;

$$◁ = (\kappa H^{-}, -H^{m}) \qquad (20)$$

2- Similarly to the above; positive color charges with their magnetic color can be shown by ▷, so that;

$$\Rightarrow (\lambda H^{+}, +H^{m}) \qquad (21)$$

The signs (+and -) of $(+H^{m}), (-H^{m})$ depend on the direction of movement around the color charges. In fact, there is a kind of magnetic color in the structure of a photon. Therefore, generally, a photon is given by;

$$n|\quad\rangle + n|\quad\rangle = |E\rangle \qquad (22)$$

In the quantum mechanics of any general field, plane waves of specific spin can always be written in terms of photons with a simple spin state and a general spatial wave function. Thus the fundamental entity, the photon, can be considered quite generally to be a plane wave with a circularly polarized spin component (Any field can be built from these basic ingredients).

For simplicity, consider a photon traveling in the x direction, or consider the direction of the photon as choosing the coordinate axis so that x points along the photon's momentum vector. Every element in the photon (relation 22) moves with linear speed in

the same direction as the photon.

The Dirac equation results for total energy are given by;

$$E^2 = \left| \alpha_0 mc^2 + \sum_{j=1}^{3} \alpha_j cp_j \right|^2 \qquad (23)$$

Comparing relationship (22) with equation (23), the energy equation can now be written as;

$$E^2 = (n|\lessdot| + n|\gtrdot|)^2 \qquad (24)$$

The roots of relations (23) and (24), are given by;

$$E_- = -\sqrt{\alpha_0 m_0 c^2 + \sum_{j=1}^{3} \alpha_j c p_j} = n \lessdot = n(\kappa H^-, -H^m) \qquad (25)$$

$$E_+ = +\sqrt{\alpha_0 m_0 c^2 + \sum_{j=1}^{3} \alpha_j c p_j} = n \gtrdot = n(\kappa H^+, +H^m) \qquad (26)$$

In pair production, relation (25) defines an electron and relation (26) defines a positron. We saw that a photon (γ-ray) produces two charged particles, an electron and positron with negative and positive charges. Before production, we have two electric and two magnetic fields. After production, there are two particles with electric field and two weak magnetic fields around them.

This phenomenon shows that an electric field has no charge effect when formed of two kinds of color-charge, namely negative color-charge and positive color-charge.

Moreover, in pair production, negative color-charges combine with each other to make a negatively charged particle, and positive color-charges combine with each other to make a positively charged particle. The magnetic colors with different direction move around the electron and positron. Consider relations (25) and (26), given by;

$$E_- = n \lessdot = n(\kappa H^-, -H^m)$$

$$E_+ = n \gtrdot = n(\kappa H^+, +H^m)$$

The pair annihilates each other to form energy. In addition, there is no electric effect around the photons, so;

$$n \triangleleft + n \triangleright = \gamma + \gamma \qquad (27)$$

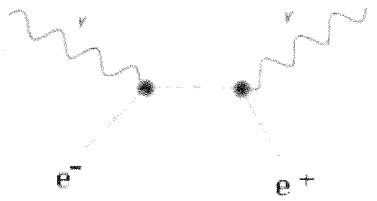

Fig1: annihilation of a particle pair

In this process, each particle (electron and positron) decomposes to two parts. Each part of the electron combines with each part of the positron and converts to quantum energy (see figure1). This phenomenon shows that the electron is divisible.

Physicists use this phenomenon as a way to confirm the mass-energy equation $E=mc^2$, but in fact, there is another important concept inherent in pair annihilation since;

$$n \triangleleft + n \triangleright = (\frac{n}{2} \triangleleft + \frac{n}{2} \triangleright) + (\frac{n}{2} \triangleleft + \frac{n}{2} \triangleright) = \gamma + \gamma \qquad (28)$$

These photons are neutral and they carry two electric and magnetic fields. This phenomenon is acceptable only where two opposite charged particles separate and recombine again.

9 Hawking Radiation

In a simplified version of the explanation, Hawking predicted that energy fluctuations from the vacuum cause the generation of particle-antiparticle pairs near the event horizon of a black hole. One of the particles falls into the black hole while the other escapes before they

have an opportunity to annihilate each other. The net result is that to someone viewing the black hole, it would appear that a particle has been emitted.

How is Hawking radiation explainable by the equation for the ZPE? To resolve this problem, there are three aspects of a black hole to consider;

- The density of gravitons is extremely high around a black hole
- Gravitons convert to photons readily
- The Dirac equation shows how photons produce matter and anti-matter.

According to the above expression, the space around a black hole produces high-energy photons whose energy is enough for pair production.

In a black hole situation, n becomes large, so E^2 (relation 24) is comparable to the total mass of a particle and anti-particle. This process does not need to take into account the time factor that the uncertainty principle dictates in relation (2). So, pair production is a common occurrence around a black hole.

10 Dynamics of charge particles of CPH Theory view point

Consider the electron and positron that give by relations (20) and (21). The electron contains a set of negative color charges that keeps by magnetic colors. This rotational sphere-like (electron spinning) is in a sea of gravitons. Gravitons are negative and positive charges color. Around the negative color charges of an electron is a magnetic field.

The electron has two opposite effects on color charges around itself. Negative color charges of electron absorb positive color charges (of space) and repel negative color charges. Magnetic field contracts positive color charges and repels them (see Ampere law).

Now we can define an operator for producing positive electric force particle. Let us show this operator by ( ) per time that acts on the electron and produces positive electric force. So, it given by;

$$\frac{d}{dt} \langle s \rangle = a \langle H^{+}, + H^{m} \rangle \qquad (29)$$

There, a is a natural number. Consider that $\langle s \rangle$ is a set of positive color charges, it makes a positive electric field around the electron. This electric field repels the negative charge particle, because every negative charge particle produces same electric field.

Same as above, positron produces a negative electric field around itself. So, it given by;

$$\frac{d}{dt}|s\rangle = a|\cdot\rangle = a(\hat{H}^{-} - H^{m}) \qquad (30)$$

When a negative electric force particle ($|a\cdot\rangle$) reaches to positron, it combines with positive electric force particle $|a\cdot\rangle$ and they convert to quantum energy, so that;

$$|a\rangle + |a\cdot\rangle = E \qquad (31)$$

This quantum energy transfers to the positron. Then, the positron accelerates toward the electron. The same process happens for the electron, and they absorb each other. For understanding, this process reconsiders to the annihilation of pair. Opposite interaction happens between two same charge particles, and they repel each other.

In fact, the structure of a virtual photon is difference from a real photon. There are different kinds exchange particles that carry electromagnetic interaction, one is a positive photon and other one is a negative photon. This point of view is able to explain easily the interaction between charge particles. In other words;

$$\frac{d}{dt}\langle s| = \gamma^{+} \qquad (32)$$

$$\frac{d}{dt}|s\rangle = \gamma^{-} \qquad (33)$$

And;

$$\gamma^{+} + \gamma^{-} = \gamma \qquad (33)$$

This view shows why a virtual photon is invisible.

11 Strong Interaction and CPH Theory

This section shows how positive charge particles absorb each other in very small distance. Generally, two positive charged particles produce banding energy, in small distances.

According to quantum chromodynamics, a proton is made of two up quarks (u) with (+2/3) charge and a down quark with (-1/3) charge. How it is that two up quarks with positive charged do not repel each other?

Generally, suppose two positive charged particles A and B are at far distance from each other. As explained in section 10, any positive charged particle absorbs negative color charges and repels positive color charges. When the distance between A and B is greater than the atomic radius, they emit negative photon γ^-. There are three locations around each positive charged particle (figure2).

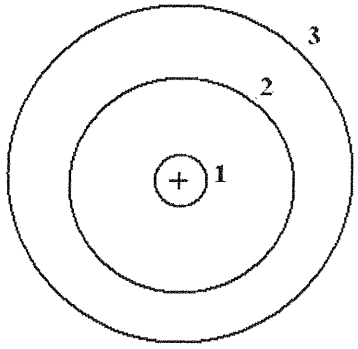

Fig2; Locations around each positive charged particle

In real space, every charged particle is plunging in a sea of gravitons. Location 3 (figure2) is full of gravitons that move with speed of $v \geq c$. When gravitons reach to location 2, electrical field (or magnetic field) of charged particle acts on them so that gravitons convert to positive and negative color charges. Positive charged particle repels positive color charges and absorbs negative color charges. Therefore, negative color charges enter into location 1 (figure2). In location 1, negative color charges convert to negative photon that given by (relation 33). In general, location 3 is full of gravitons, location 2 is full of negative and positive color charges, and positive charged particle generates negative photon in location 1. Now suppose two positive charged particles (A^+ , B^+) are near each other that location 2 interferes with each other (Figure3).

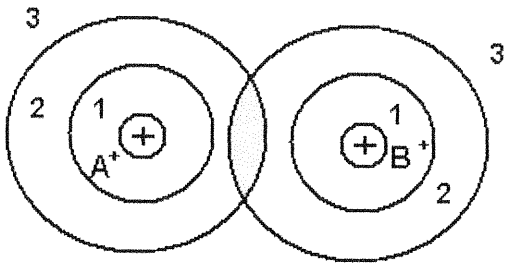

Fig 3; interconnect two positive charged particles

Locations 2 of A and B interconnect, there is a set color charges generated by A, described as follows:

$$\{(H^+, H^-) \big| H^+, H^- \in \text{field A}\}$$

Charged particle A repels positive color charges (H^+), they move toward B particle, and negative color charges (H^-) move toward A.

Also, charged particle B generates a set of positive and negative color charges (H^+, H^-) as follows;

$$\{(H^+, H^-) \big| H^+, H^- \in \text{field B}\}$$

Their direction movement is the opposite of A production. Therefore, in location 2, positive color charges H^+ from A and negative color charges H^- from B, have the same direction movement that is toward the B particle. They combine and convert to electromagnetic energy and move toward the particle B. The same action happens for positive color charges H^+ from B and negative color charges H^- from A; so, they form quantum energy that moves toward A. This shown as follows;

$$|a>\rangle + |a<\rangle = E$$

These energies form the banding energy between A and B. In a heavy nucleus, that contains a lot of protons, every quark interacts with each other and produces banding energy

Consider the centre of stars, two hydrogen ions (protons) move toward each other, when their distance decreases, then locations 2 of them interconnect and produce banding energy.

12 Weak interaction

In the Standard Model of particle physics, it is due to the exchange of the heavy Z^0 , W^+ , W^-. Its most familiar effect is beta decay and the associated radioactivity. Consider a neutron (contents one up quark, two down quarks). Although the neutron is heavier than its sister nucleon, the proton (contents *uud*), it cannot decay into a proton without changing the flavor of one of its down quarks. Neither the strong interaction nor electromagnetic allow flavor changing, so this must proceed by weak decay. In this process, a down quark in the neutron changes into an up quark by emitting a W^- boson, which then breaks up into a high-energy electron and an electron antineutrino. Since high-energy electrons are beta radiation, this is called beta decay.

$$^{137}_{55}\mathrm{Cs} \rightarrow {}^{137}_{56}\mathrm{Ba} + e^- + \bar{\nu}_e$$

In the above formula, a neutron udd (two down quarks $2\times-\frac{1e}{3}$ and one up quark $+\frac{2e}{3}$ electric charge) decays to a proton (uud $2\times+\frac{2e}{3}$ and $-\frac{1e}{3}$ electric charges), with +e electric charge. Before reaction, there is no integer charge in neutron structure, but after reaction, there is an electron with –e electric charge. Suppose an electron formed of $E_-=n<$, therefore, a down quark given by $\frac{n<}{3}$, and an up quark shown by $\frac{2n>}{3}$. It is attendable that a quark over that negative (or positive) color charges contains electromagnetic energy ($|a>\rangle+|a<\rangle=E$), so the mass of up quark is not equal the mass of $\frac{2n>}{3}$. For example; in β^+ decay with +e electric charge that is equivalent of $n>$, consider the following relation;

$$\text{energy} + p^{+} \rightarrow n^{0} + e^{+} + \nu_{e}$$

A n^{0} contains two down quarks [2× ($-\frac{1e}{3}$ or $\frac{n<}{3}$)] and one up quark ($+\frac{2e}{3}$ or $\frac{2n\triangleright}{3}$), but a proton contains [2× ($\frac{2n\triangleright}{3}$ or $+\frac{2e}{3}$)] and one down quark ($-\frac{1e}{3}$ or $\frac{n<}{3}$).

So, in above formula, energy separates color charges and recombines them in a new form. There is a positron with integer($n\triangleright$ or $+e$)electric charge, in right side of above formula, but there is not so integer electric charge, in left side. Therefore, electric charge of particles is not stable, but the color charges conserved. It meant that the sum number of negative and positive color charges is equal in any reaction. Therefore, vector bosons Z^{0} و W^{+} , W^{-} given by;

$$W^{+} \sim n\triangleright$$

$$W^{-} \sim n<$$

$$Z^{0} \sim (k\triangleright + k<)$$

Summary;

According to this article we have generalized color charge from the nuclear regime to the photon. This new view of color charge means that we can redefine the graviton and electromagnetic energy. Gravitons behave like charged particles and in the interaction between gravity and the photon, gravitons convert to negative and positive color charges and magnetic color. These color charges and magnetic color form the electromagnetic energy. Electromagnetic energy converts to matter and anti-matter as charged particles. Space is full of gravitons. Gravitons interact with each other and convert to color-charges. These color charges and magnetic color form electromagnetic energy.

This view shows how particles appear and when Spontaneous Symmetry Breaking has occurred.

$$|V_{CPH}(x)|+|V_{CPH}(y)|+|V_{CPH}(z)|=|V_{CPH}|>c$$

CPH has not spin

CPH is isolation that never seems.

$|V_{CPH}(x)|+|V_{CPH}(y)|+|V_{CPH}(z)|<|V_{CPH}|$. CPH has spin

When CPH has spin, it calls graviton

Space (vacuum) is full of CPH (gravitons), and CPH produces energy.

$$|V_{CPH}(x)|+|V_{CPH}(y)|+|V_{CPH}(z)|\geq c$$

Gravitons convert to negative and positive color charges and magnetic color.

$$|V_{CPH}(x)|+|V_{CPH}(y)|+|V_{CPH}(z)|\leq c$$

Electric and magnetic fields appear.

$$|V_{CPH}(x)|+|V_{CPH}(y)|+|V_{CPH}(z)|<c$$

matter and anti-matter appear

Spontaneous Symmetry Breaking has occurred. Moreover, fundamental particles appear, then fermions and bosons interaction with each other. For example, reconsider pair production, before pair production, there is a photon only. There is an electron a positron and virtual photon (boson) that carries electric force, after pair production.

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